



September 6, 2013

PRINCIPALS

Theodore A Barten, PE

Margaret B Briggs

Michael E Guski, CCM

Dale T Raczyński, PE

Cindy Schlessinger

Lester B Smith, Jr

Robert D O'Neal, CCM, INCE

Andrew D Magee

Michael D Howard, PWS

Laura E Rome

Douglas J Kelleher

AJ Jablonowski, PE

Samuel G Mygatt, LLB
1943-2010

ASSOCIATES

Stephen H Slocomb, PE

Maureen A Cavanaugh

David E Hewett, LEED AP

3 Clock Tower Place, Suite 250
Maynard, MA 01754
www.epsilonassociates.com

978 897 7100
FAX 978 897 0099

Nantucket Conservation Commission
2 Bathing Beach Road
Nantucket, MA 02554

Subject: Supplemental Submission for Baxter Road and Sconset Bluff Storm
Damage Prevention Project (DEP File No. SE 048-2581)

Dear Commissioners:

Enclosed please find supplemental information for the above-referenced project.
This submission includes the following components:

- Responses to questions from the Commission asked at the August 28, 2013 public hearing.
- Responses to the letter from Ms. Rebecca Haney of the Massachusetts Office of Coastal Zone Management dated August 26, 2013.
- Responses to the comment letter from Applied Coastal Research and Engineering dated August 28, 2013.
- A proposed Sand Mitigation Plan and Monitoring System.

Please contact me at (978) 461-6212 or via email at lsmith@epsilonassociates.com for any questions regarding this submission.

Sincerely,

EPSILON ASSOCIATES, INC.

Lester B. Smith, Jr.
Principal and Coastal Geologist

cc: DEP-Southeast Region, Jim Mahala
MACZM, Rebecca Haney

**BAXTER ROAD AND SCONSET BLUFF STORM DAMAGE PREVENTION PROJECT
NOTICE OF INTENT (DEP FILE NO. SE 048-2581)**

**RESPONSES TO QUESTIONS FROM NANTUCKET CONSERVATION COMMISSION ASKED AT
PUBLIC HEARING ON AUGUST 28, 2013**

September 6, 2013

To assist the Commission and the public with the review of the NOI, SBPF is presenting specific responses to the topics that were covered at the public hearing on August 28, 2013. The format of this document is to present a brief summary of each comment or question in bold followed by a response in regular text.

QUESTIONS/COMMENTS FROM CONSERVATION COMMISSION MEMBERS

Provide potential barge landing locations.

Figure 1 shows the location of potential barge landings. The barge landings are in the nearshore sandy sediment/benthic zone along the Sconset Beach, which is a very dynamic zone and is not a productive habitat as is the case of the offshore cobble habitat zones.

This figure also includes "Viewport Locations" labeled TS4, TS5 and TS6 which were prepared by Coastal Planning & Engineering (CPE) as part of the benthic community investigations for the proposed Sconset Beach Nourishment Project (see attached report). These "Viewport Locations" represent a combination of (1) high resolution side scan sonar (SSS) investigation of the seafloor to map benthic habitat (including cobble bottom) areas and (2) underwater nearshore transects surveyed via a marine biologist using scuba and underwater videography to record benthic habitats as well as fish species observed. Benthic habitats were grouped into three classifications: sand, sporadic cobble and cobble. The three transects in the revetment project area (TS4, TS5, TS6) have a sand benthic habitat nearest the beach with either sporadic cobble (as in TS4) or cobble habitat progressively seaward. Sand habitat is generally a very dynamic zone with few benthic organisms present. It was determined that cobble habitat located farther offshore may serve as a nursery for juvenile black seabass or other fish species.

Potential barge landing locations have been identified along the beach and in the sand habitat zone. None of the potential barge landing locations are located within cobble habitat and the beaching of the pier barge would not impact cobble habitat or other sensitive habitat areas. Since this sand zone is very dynamic with few benthic species present, potential impacts to benthic habitats by landing a barge along the beach is determined to be negligible.

Provide additional information on the sediment budget.

As previously submitted (see “Supplemental Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 8, 2013” dated August 23, 2013), the Sconset shoreline is highly dynamic. The rate and direction of sediment transport within the Project area are highly variable and therefore not predictable. There is evidence of bi-directional longshore sand transport, with gross transport exceeding the net transport. The direction of sand transport varies depending upon the combined influence of storms, prevailing wind waves, and tidal currents due to the differing tidal regimes on the south and east sides of the island that converge in the Project vicinity. The offshore system of shoals evolves as well, which affects beach sediment transport. Ultimately, the direction of littoral drift at any one location can (and does) change; these changes are dynamic and unpredictable.

Given the dynamic and complex nature of the littoral system at Sconset, any estimate of a detailed sediment budget describing specific locations to which various quantities of sediment eroded from the bluffs are transported would be subject to enormous uncertainty. This uncertainty associated with the sediment budget means that there are no reliable or meaningful data available regarding the location to which sediment is transported upon which a reasonable basis for determining an appropriate mitigation program can be developed. Therefore, we continue to assert that the Project should follow the state standard of “Best Available Measure,” which is to provide to the littoral system, on an annual basis, the average amount of sand that would have been provided by the eroding bank absent the project. We reached out to CZM and DEP at the outset of this Project to confirm this standard, and this was the agreed-upon approach.

Finally, we note that the same conclusion was arrived at previously by Applied Coastal Research & Engineering during review of the Sconset beach dewatering project. At that time, Applied Coastal recommended that a mitigation volume should be based on bank retreat rates because of the highly dynamic nature of the Sconset shoreline and the difficulty of determining a sediment budget. See the following explanation from John Ramsey in a letter dated December 16, 2003 [emphasis added]:

“As described above, erosion of the Sconset bluff provides sediment to the regional beaches, and **the system is too complex to determine where bluff-derived sediment will migrate to following a storm.** Likewise, it is likely too complex to develop a monitoring program that could effectively capture the impacts of the proposed bank stabilization project on regional beaches. **A more simplistic approach has been adopted by DEP for similar projects and is based upon long-term erosion rates.** It is assumed that the bank is a sediment source to downdrift shorelines (beaches, dunes, estuaries, etc.) and **the volume prevented from eroding should be mitigated via beach nourishment. This approach should provide the basis for long-term mitigation strategies associated with this project.**”

Provide more information on the potential settlement of the revetment when wet or influenced by waves.

See attached memo from Ocean and Coastal Consultants dated September 5, 2013. In part, the memo states the following:

“Since the weight of the overlying revetment materials would be the cause of the settlement, and the revetment weight is actually maximum during low water conditions, the condition was modeled with a moist unit weight (γ) rather than as a submerged condition. If the revetment material is modeled as being submerged, then buoyant/effective weight, saturated minus unit weight of water ($\gamma_{sat} - \gamma_w$), would be used, reducing the overall weight. The saturated, but not submerged, condition yields an estimated settlement on the conservative side in terms of varying water levels.

“Wave impacts can be modeled in Plaxis as a distributed surface load, but only a "permanent" vertical component of the load would actually cause settlement. Wave loads are usually considered transient. Wave loads were not modeled since they would not have any impact on the settlement.”

The memo concludes [emphasis added]:

“Two conditions of the proposed revetment were analyzed in Plaxis: (a) with a sacrificial sand berm at the toe (Figure 1); and (b) without the berm (Figure 2). **The maximum potential vertical settlement for both conditions is only about 0.6 inch, which is negligible compared to the amount of sand removed and the revetment material placed and unlikely to affect the function of the proposed revetment.** Note that more vertical settlements could be expected if weaker soils are actually found within the assumed extent of coastal beach sand.

“Since the materials assumed to be involved are coarse-grained, most of the vertical settlements would occur as the revetment material is being placed.”

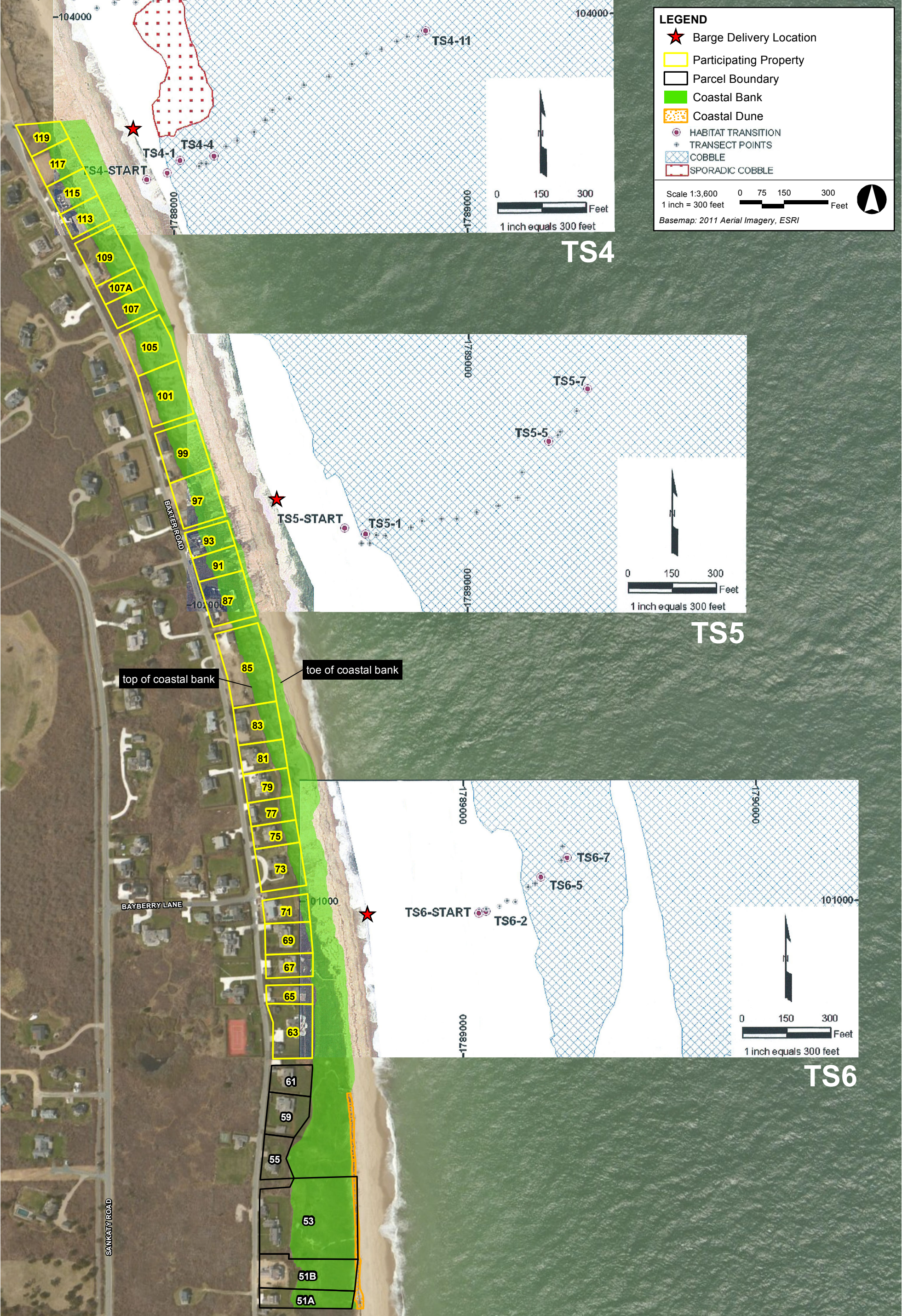


Figure 1
Barge Delivery Locations and Benthic Habitats

**SCONSET BEACH NOURISHMENT PROJECT:
BENTHIC COMMUNITY INVESTIGATIONS**

Prepared for:

**Siasconset Beach Preservation Fund
Nantucket Island, Massachusetts**

Prepared by:

**Project Manager: Craig J. Kruempel, M.Sc.
Principal Marine Biologist: Erin Hague, B.Sc.
Marine Biologist: Jessica Craft, B.Sc.
GIS Specialist: Dave Rubin, M.Sc.**

**Coastal Planning & Engineering, Inc.
2481 NW Boca Raton Blvd.
Boca Raton, Florida 33431**

September 2006

SCONSET BEACH NOURISHMENT PROJECT: BENTHIC COMMUNITY INVESTIGATIONS

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1.0 INTRODUCTION

The Sconset Beach Nourishment Project (the "Project") is a privately funded large-scale beach nourishment project proposed to protect Sankaty Head Lighthouse, portions of the Town of Nantucket's wastewater facilities, Town roads, private properties, and historic structures along the eastern shoreline of Nantucket Island (see Figure 1). The Project is needed to protect and restore the Sconset shoreline. The purpose of this report is to present the findings of a benthic characterization survey of the Project area conducted on August 4 and 5, 2006. The survey provides support for the Environmental Impact Report for the Project in response to agency request.

1.1 Project Overview

The Sconset Beach Preservation Fund (SBPF) has identified the need for a nourishment Project to protect approximately four miles of critically eroding coastline along the eastern margin of Nantucket Island. This stretch of shoreline has undergone extensive landward retreat as a result of coastal storms and beach scour, which have resulted in undercutting and collapse of a Coastal Bank extending along much of the Project area. As a result, the Project is needed to protect public and private property at the top of the bank as well as significant infrastructure and historic structures such as the Sankaty Head Lighthouse.

Specifically, the Project will provide nourishment of approximately four miles of critically eroded shoreline extending south from Sesachacha Pond, past the Sankaty Head Lighthouse, through the village of Siasconset and south to the Town Sewer Beds located south of Codfish Park. The Project involves placement of a substantial volume of beach-compatible sand along the shoreline to build a wide, high beach to protect the eroding Coastal Bank and threatened upland property and structures.

A potential benefit of the project is the restoration of critically eroded shorelines that have historically supported significant nesting habitat for shorebirds. Two species of listed shorebirds, the Piping Plover (*Charadrius melodus*, a State and Federally-listed threatened species) and Least Tern (*Sterna antillarum*, a State-listed species of special concern), are known to occur within the Project area. While portions of the Project area have historically been identified by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) as Estimated Habitat for these species, much of the Project shoreline is currently unsuitable for nesting shorebirds with large stretches of this shoreline consisting of very narrow beaches abutted by the steep Coastal Bank. This narrow beach is frequently overwashed by waves during high tides and storms, making it unlikely to attract nesting Piping Plovers and Least Terns.

1.2 Project Objective and Need

The immediate Project objective is to construct a nourishment profile that will provide protection to upland resources. A wider and higher beach profile will provide storm

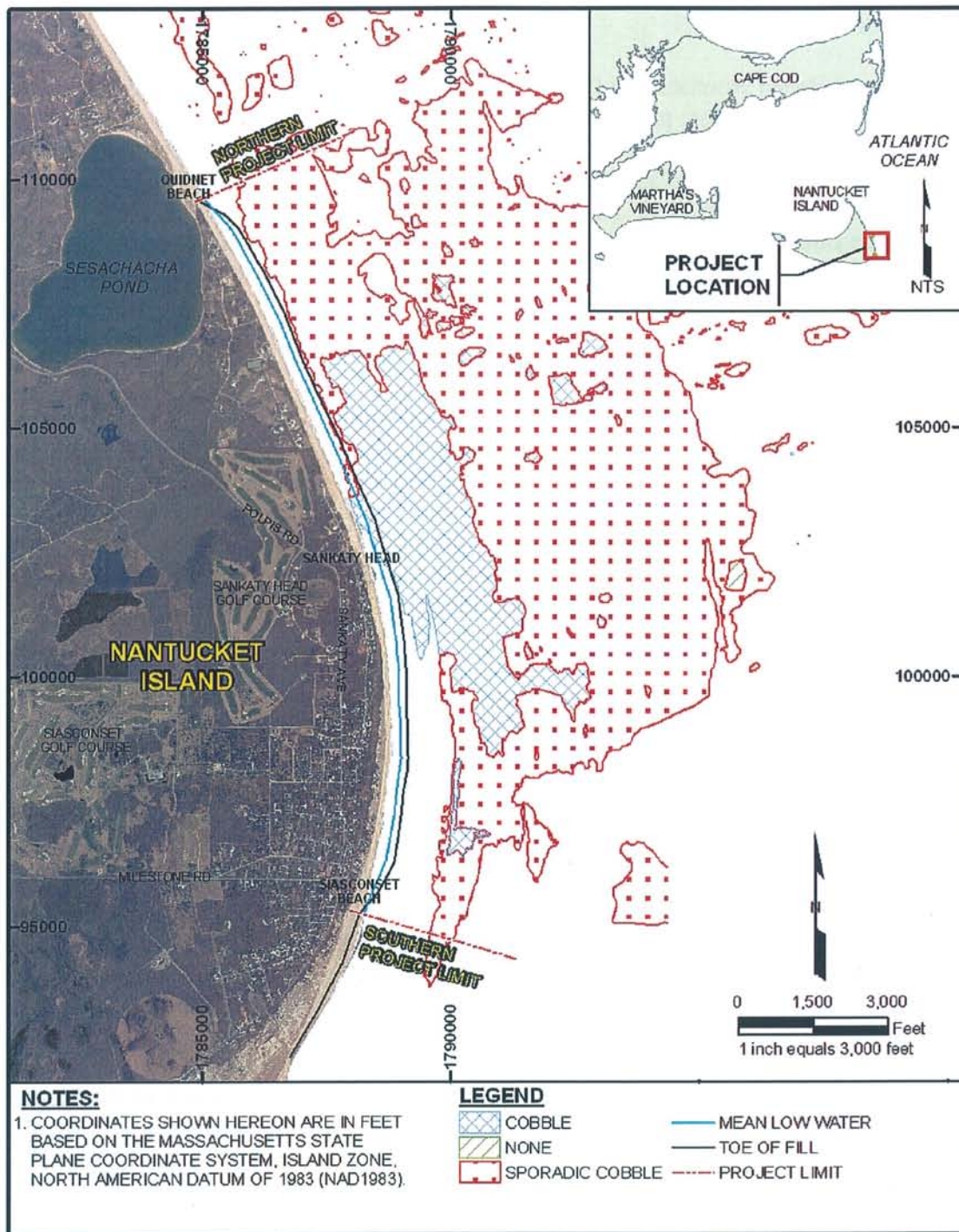


Figure 1. Project Location Map

damage protection for the historic Sankaty Head Lighthouse (a National Historic Monument), public infrastructure (such as roads, water and wastewater pipelines), and approximately 80 residential homes constructed prior to the adoption of the Wetlands Protection Act in 1978. The Project will also protect public infrastructure and remaining portions of the historic Sconset Bluff Walk, a major tourist attraction that is endangered by the critical erosion. Finally, the Project will preserve and maintain the natural beauty of Sconset Beach so that this valuable resource will continue to be available for use by the residents and visitors of Sconset Village and the Town of Nantucket.

The long-term Project objective is to preserve the infrastructure and beaches along the entire Sconset shoreline. The Nantucket Planning and Economic Development Commission (NPEDC) credits Sconset's history, character, and distinctiveness for making it one of Nantucket's chief tourist attractions (NPEDC, 2004). In its long-term plan for the village, the NPEDC describes Sconset as a "living community that continues to have a strong sense of itself" and declares that the layered history of homes along Baxter Road "and their open stance on the bluff is a marvelous aspect of the town". Further, the Commission states that one of its goals is to preserve and enhance the sense of place and community that Sconset encompasses and portrays. This is a goal with which this proposed Project is wholly compatible.

The proposed Sconset Beach Nourishment Project will provide protection to hundreds of homes in Sconset, including many over 100 years old and some in excess of 300 years old. By stabilizing the eroding shoreline, the Project will protect the unique character and history of Sconset, preserving this distinct community and its contributions to Nantucket. Without this Project, a vital and historic part of Sconset will eventually be lost, to the detriment of Nantucket as a whole. Furthermore, the Project will serve as a privately funded demonstration of a large-scale nourishment effort that may provide guidance on the viability of this shore protection alternative for New England, in support of the SBPF mission.

1.3 Site Description

Sconset Beach is located along the eastern shoreline of Nantucket Island, which lies approximately 28 miles south of Cape Cod, Massachusetts. The village of Sconset was first settled three centuries ago as a whaling outpost. In 1850, the Sankaty Head Lighthouse was built on the bank's edge overlooking the Atlantic Ocean. This historic lighthouse still stands today, serving as an active aid to navigation. Presently, the village almost exclusively consists of private homes, many of which date back to fishing shanties from the 17th and 18th centuries. Much of the village is located along the Sankaty Bluff, which rises nearly 27.5 meters (90 feet) above the beach and Atlantic Ocean. To the north and south, this Coastal Bank tapers down in elevation until it gives way to Coastal Dune. The Coastal Beach fronting the bank and dune resources is relatively narrow, providing little protection from storms. Shoreline change and bank retreat data show that erosion at Sconset Beach has increased significantly in recent years. Over the last 15 years, average retreat rates for the bank and dune were 1 meter/year (~3 feet/year) and 3

meters/year (~10 feet/year), respectively, with localized erosion of 1.5-3 meters (~5-10 feet) and 12-18 meters (~40-60 feet) experienced during the winter of 2005.

1.4 Environmental Setting

The Project is located in a highly-dynamic coastal environment which experiences strong current and frequent storms. Rapid tidal changes produce extreme current (nearshore surface currents can reach 3.8 knots; offshore surface currents may reach speeds of 4.2 knots) at the peak of ebb and high tides. Strong nearshore tidal currents may significantly dictate sediment transport and contribute to steepening of the beach face. They also contribute to the poor visibility in the water column which averaged 2-3 meters (~7-10 feet) during the benthic survey.

Coastal Beach is relatively narrow in the northern and central portions of the Project area, and gradually widens southward toward Codfish Park. Coastal Bank is highest (approximately 27.5 meters/90 feet) in the central portion of the Project area and gradually decreases in height to the north and south. This Coastal Bank is relatively steep, making it particularly susceptible to collapse.

1.4.1 Habitat Areas

The proposed Project falls entirely within coastal wetland resource areas subject to protection under the Massachusetts Wetlands Protection Act (Massachusetts General Law Chapter 131 Section 40) (the "Act") and accompanying Wetlands Protection Act Regulations (310 CMR 10.00). The proposed Project also occurs within wetland resource areas subject to protection under the Town of Nantucket Bylaw for Wetlands Section 136-7 (the "Bylaw") and the accompanying Town of Nantucket Wetland Protection Regulations. Protected Wetland Natural Resources in the Project area include Coastal Beach, Coastal Bank, Coastal Dune (primarily in the vicinity of Codfish Park), Land Under the Ocean (subtidal), and the overlay resource area of Land Subject to Coastal Storm Flowage. Depending on the time of year, coastal wetland resources in the Project area provide wildlife habitat for a diverse coastal ecosystem populated by upland and marine mammals, shorebirds (including listed species), surf zone finfish and ichthyoplankton (i.e., fish larvae), and intertidal and nearshore benthic organisms (e.g., mole crabs and other shellfish and benthic invertebrates). Initial research of the project area has also implied the presence of cobble/glacial boulder habitat, which, according to the New England Fishery Management Council, is known to provide critical habitat for juvenile managed fisheries species.

2.0 ASSESSMENT METHODS

Coastal Planning & Engineering, Inc. (CPE) marine biologists, assisted by biologists from MRI/Normandeau Associates, conducted a benthic community assessment in the Project area on August 4 and 5, 2006. Prior to the underwater field investigations, CPE marine biologists reviewed related literature, collected data from resource management agencies, and reviewed preliminary field data.

Six (6) temporary nearshore transects and four (4) temporary offshore transects were chosen based on results of a high resolution sidescan sonar investigation of the seafloor within the project area (Figure 2). The purpose of the sidescan sonar (SSS) was to describe bathymetric and physical attributes of the benthic habitat and to delineate areas of cobble bottom within and adjacent to the project area. The purpose of the mapping effort is to facilitate development of an impact assessment based on the nature and extent of resources that may be effected by project construction (Figure 2). Transect locations were based on coverage by cobble habitat and areas showing distinct habitat transitions (i.e. sand to cobble) determined by SSS. Each transect was filmed by qualified marine biologists using underwater videography to confirm remotely sensed SSS data interpretation and to qualitatively assess the habitat type and condition present within the Project area. While filming the nearshore transects, marine biologists noted transitions in habitat in a nearshore to offshore orientation dictated primarily by notable changes in estimated percent cover and average size of cobble. Observations also included a species list of fish and benthic species present, percent cover of cobble habitat and class size, and species type and approximate abundance of finfish in each transition zone.

3.0 RESULTS

3.1 Nearshore Transects

Nearshore transects were established perpendicular to the shoreline in order to intersect the change in habitat types oriented parallel to the coastline. Marine biologists worked in currents up to 1.5 knots or greater, which often influenced the transect line orientation at an angle slightly to the north or south, depending on the ebb or flood tide (See Figure 3). In general, the natural progression observed by marine biologists along each transect from onshore to offshore was: sand; sporadic small (<10% cover; <30 cm/12 in) cobble; sporadic (10-20% cover) cobble mixed with occasional large boulders (90 cm/36 in to 150 cm/60 in); moderate cover (20-40%) of medium-sized (30 cm/12 in to 90 cm/36 in) cobble with occasional large boulders; ending offshore with a higher percent cover (>40%) of medium-sized cobble with occasional large boulders. This transition, however, is a generalization of the overall area as some differences between transects were observed.

Transect 1 (TS1) differed from the other transects in that it was primarily sand with some small, sporadic cobble documented toward the offshore end. Transects 2 (TS2) and 3 (TS3) exhibited the typical transition from sand at the onshore end of the transects, to sporadic cobble, to denser cobble with large intermittent boulders occurring at the offshore end of the transects. Transects 4 (TS4) and 5 (TS5) had smaller cobble present than that found along other transects (no cobble observed over 16 inches).

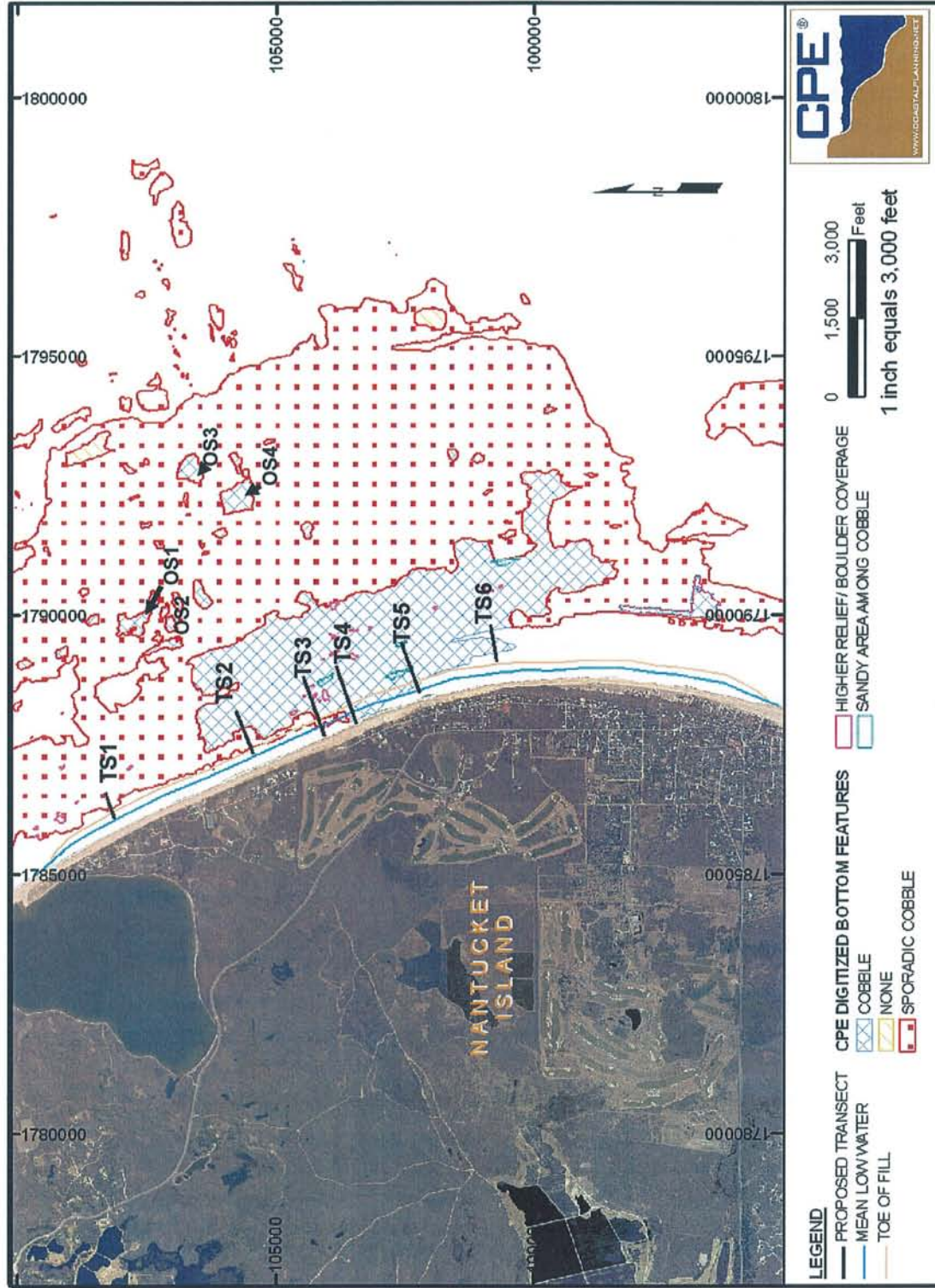


Figure 2. Proposed Location of Benthic Transects.

Documentation at Transect 6 (TS6) identified the highest percent cover of large boulders at this site with the largest boulders observed along any of the transects, some reaching diameters over three meters (10 ft) (Figure 4). On all of the transects, transition into cobble habitat from sand was typically marked by the appearance of a coarse gravel/rubble component mixed with sand. Tables 1a and 1b provide the percent cover of cobble along each transect as identified by diver observation and analysis of the video record.

Table 1a. Size and percent cover cobble per transect (TS1-TS3). Transitions are numbered in order from offshore (OS) to nearshore (NS) and correspond to transitions shown in Figure 7 (though sometimes in reverse order if the transect was run from nearshore to offshore).

Transition	TS1		TS2		TS3	
OS->NS	% Cover	Size (in)	% Cover	Size (in)	% Cover	Size (in)
Start	50	6-12	50	24-36	50	12-36
1	10	6-12	50	24-36	50	24-48
2	0	sand	28	12	20	12-36
3			0	sand	10	12-24; 60
4			50	12-36	<10	12-24
5			10	36-60		
6			85	12-36; 60		
7			<10	12-36		
8			50	<12		
9			0	sand		

Table 1b. Size and percent cover of cobble per transect (TS4-TS6). Transitions are numbered in order from offshore (OS) to nearshore (NS) and correspond to transitions shown in Figure 7 (though sometimes in reverse order if the transect was run from nearshore to offshore)

Transition	TS4		TS5		TS6	
OS->NS	% Cover	Size (in)	% Cover	Size (in)	% Cover	Size (in)
Start	60	8-12	0	sand	50	12-36
1	60	8-12	40	8-12	50	12-36, 60
2	20	<12	30	8-12	80	12-36; 120
3	20	8-10	10	8-12	10	6-24
4	20	8-10	20		0	sand
5	20	5-8	80	12-14; 4-6	10	12-36
6	20	8-10	0	sand	10	12-24
7	30	8-10	80	12-14	0	sand/gravel
8	40	8-14	40			
9	30	5-10	20			
10	20	5-10	80			
11	20	12-16				
12	20	4-8				

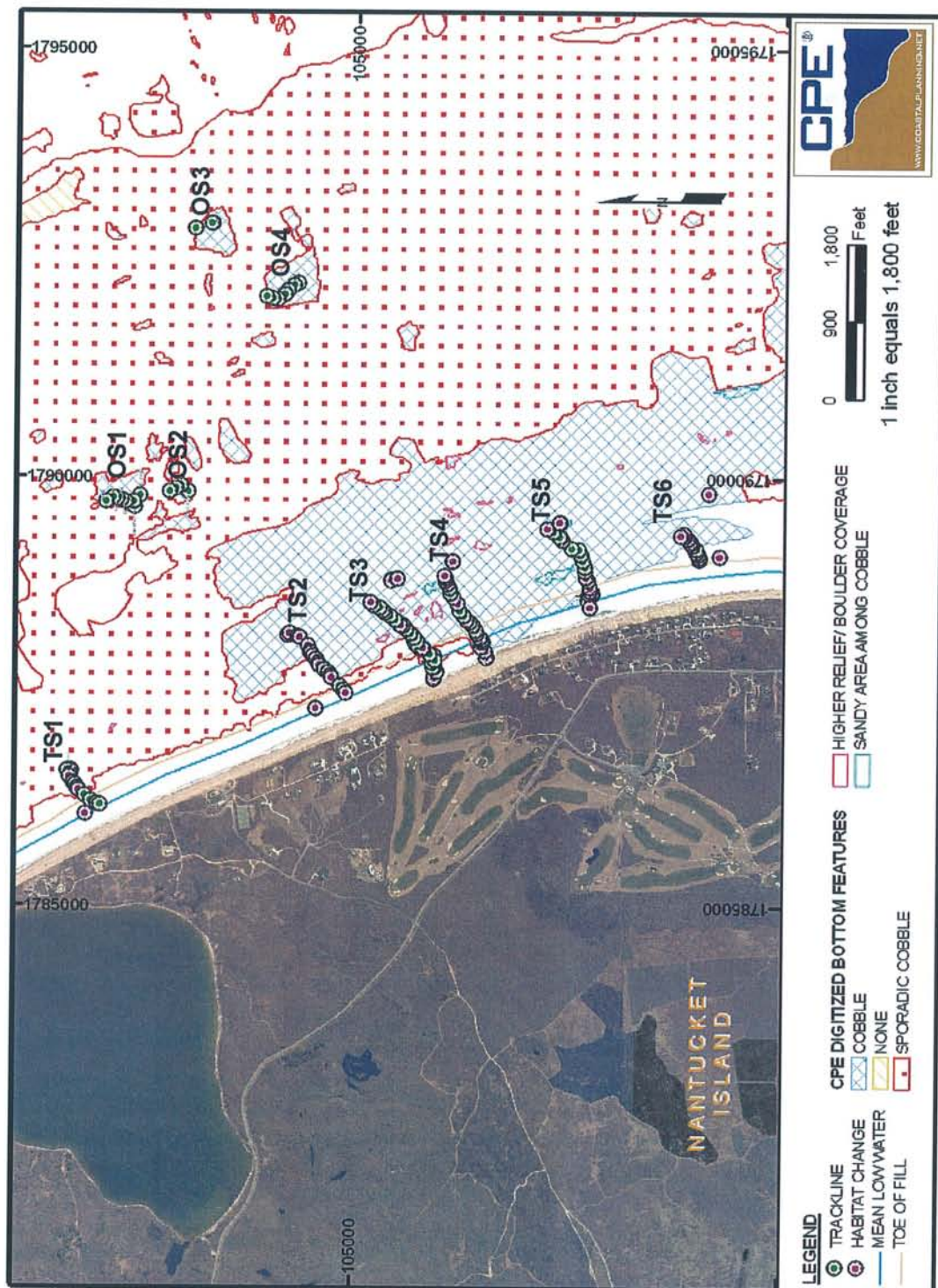
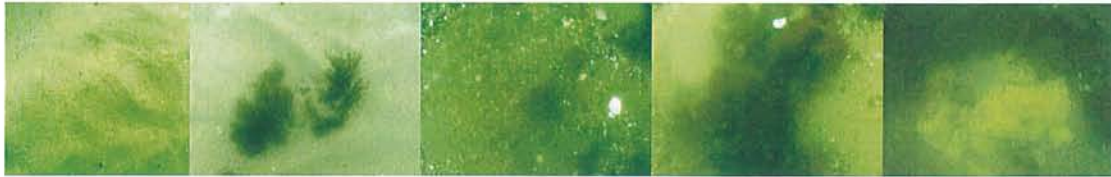


Figure 3. GPS locations of video documentation transect lines in the study area.



TS1



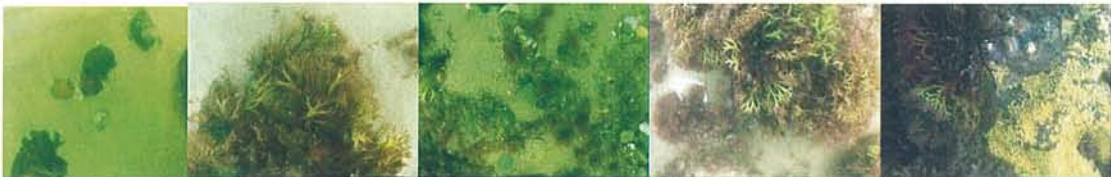
TS2



TS3



TS4



TS5



TS6

Onshore Offshore

Figure 4. Photo-documentation showing habitat progression along each nearshore transect (Photos are representative of habitat within each zone and do not necessarily correspond with transitions shown in Figure 7).

Typically, all cobble in the nearshore environment was covered in a mature (Holdt, et. al, 2006; Pringle and Mathieson, 1987) canopy of the macroalgae *Chondrus crispus*. As the transects progressed offshore, a transition from primarily macroalgae cover to sponge overgrowth by *Cliona celata* was observed. Larger boulders exhibited higher diversity of attached biota. In addition to *C. crispus*, larger boulders supported growth of multiple sponge and tunicate species including some *C. celata*, seapork tunicate (*Amaroucium pellucidum*), an invasive encrusting tunicate (*Didemnum* sp.), and occasional small colonies of the coral *Astrangia danae*. Observations at Transect 6 documented a high percent cover by the invasive tunicate *Didemnum* sp., compared with the other transects. This colonial tunicate reproduces rapidly and fouls marine habitats, and can be an indicator of enriched water (Dr. Gretchen Lambert, Personal Communication; Valentine, 2006; REEF, 2006). Divers also noted dead, often fragmented barnacles on much of the cobble along this transect and observed dead mole crabs (*Emerita talpoida*), a burrowing shoreline species, floating in a plume of turbid water that appeared to be coming from the southernmost project limit. Town Sewer Beds are located approximately 1.8 mi south of this transect. The observed biotic phenomena on Transect 6, particularly the high percent cover by *Didemnum* at TS 6, may indicate a land-based source of contamination affecting benthic habitats at the southern end of the project area.

3.2 Offshore Sites

Offshore sites were assessed in the same manner as the nearshore transects. However, the orientation of video lines across these sites was not pre-determined as with the nearshore transects (shore-perpendicular). Due to the extreme current (1.5 knots or greater) at these sites during the time of assessment, divers drifted with the current over the site while recording the habitat using underwater video (See Figure 5). Determining onshore to offshore transitions was not the goal of assessing these sites; rather, divers groundtruthed these areas based on side-scan sonar results and assessed habitat type and quality. Biologists found that Offshore Sites 1 and 2 (OS1 and OS2) differed slightly from Offshore Sites 3 and 4 (OS3 and OS4).

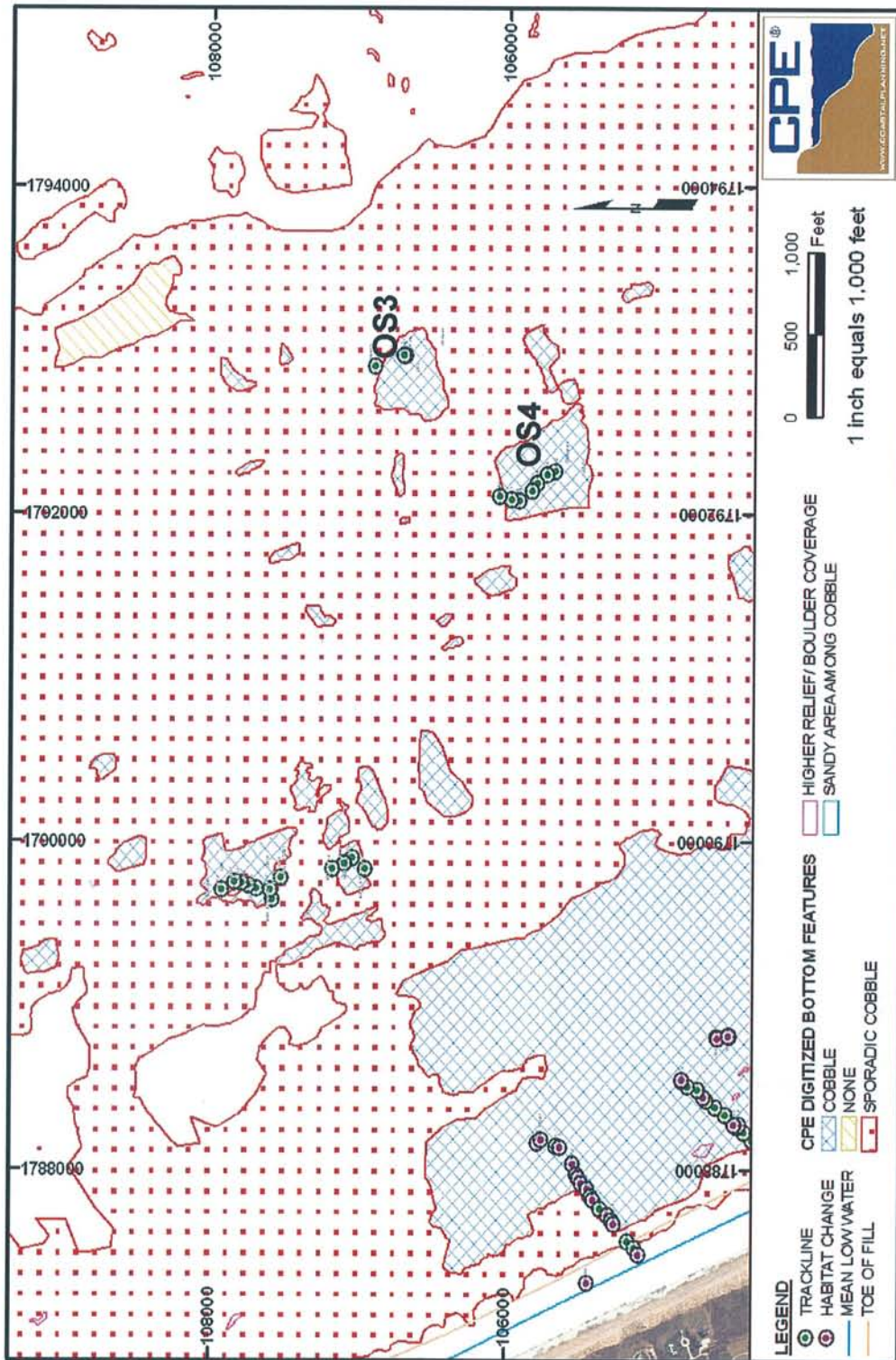


Figure 5. GPS locations of video documentation transects at the offshore sites.

3.2.1 OS1 & OS2

Offshore Sites 1 and 2 contained dense cobble (50% cover or greater) typically 30 to 90 centimeters (12-36 in) in diameter with intermittent large boulders up to two meters (7 ft) in diameter. Although the macroalgae *C. crispus* was observed on much of the cobble, a higher percent cover of the yellow sponge *C. celata* was noted at these sites when compared to the nearshore sites. Both of these sites were bordered by a perimeter of gravel and shell debris, although OS2 was less pronounced and ended abruptly in a steep sand bank. See Figure 6 for representative photos of the offshore sites.

3.2.2 OS3 & OS4

The habitat found at Offshore Sites 3 and 4 was more similar to the nearshore transects than Offshore Sites 1 and 2 (See Figure 6). Cobble here was generally smaller than that found at OS1 and OS2 (15-45 cm/6-18 in) with occasional large boulders. Percent cover of *C. crispus* was also comparable to that on the nearshore transects, and *C. celata* was not as prevalent as at OS1 and OS2.



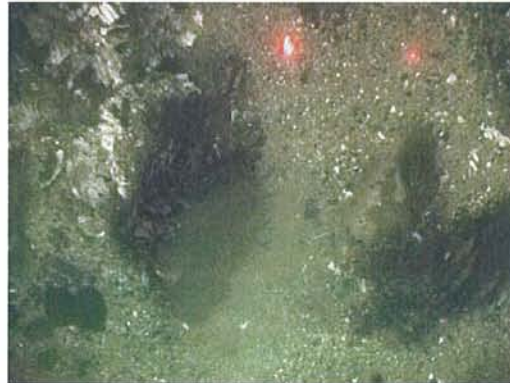
Sponge *Cliona celata* observed at OS1 and OS2



Gravel halo typical around OS1 and OS2



Macroalgae *Chondrus crispus* found at OS3 and OS4



Sand/gravel observed between cobble at OS3 and OS4

Figure 6. Representative photos of Offshore Sites 1, 2, 3 and 4. Red dots indicate video laser alignment system.

3.3 Biota

The nearshore transects exhibited a higher number of juvenile fish than the offshore sites, primarily black seabass (*Centropristes striatus*). Other common species observed include cunners (*Tautoglabrus adspersus*), butterflyfish (*Peprilus triacanthus*), rock crabs (*Cancer irroratus*), jonah crabs (*Cancer borealis*) toad crabs (*Hyas araneus*), various species of hermit crabs (*Pagurus* spp.), and moon snails (*Polynices duplicata*; *Lunacia heros*). Nearly all of the species observed on the nearshore transects were also observed at the offshore sites; however, fewer juveniles were noted at the offshore sites. In particular, more adult black seabass were observed offshore than nearshore, and schooling activity was observed at OS4. See Table 2 for a complete list of observed species, and Appendix A for photos of selected species.

3.4 Habitat Transitions

Analyses of SSS survey data revealed highly variable seafloor conditions in the nearshore Project area. These data have been used to identify zones of solid cobble, sporadic cobble, and areas of boulders and sandy sediment within cobble zones. For the purposes of this analysis, a “cobble” zone is defined as an area in which 50-100% of the seafloor is covered with cobbles (assumed as an average of 75% cobble coverage); and a “sporadic cobble” zone is defined as an area where 20-50% of the seafloor is covered with cobbles (assumed as an average of 35% cobble coverage).

Using the SSS results, marine biologists were able to confirm the location of the changes in habitat types and cover to support these findings. However, divers were able to observe more detailed shifts in habitat type and cover than what the SSS could detect (See Figures 7a-g).

The nearshore transition from sand to sporadic cobble was readily detected by both the SSS and by marine biologists. According to the benthic survey results, this habitat can generally be characterized as <10% cobble cover with sporadic areas of higher percent cover. The observed average cobble diameter typically ranged between 15 and 60 centimeters (6-24 in) with occasional larger boulders ranging in size from one to 1.5 meters (3-5 ft) in diameter. The transition from sporadic cobble to higher percent cobble cover was also documented by both SSS and researchers. The transition from the sporadic cobble to the more dense cobble habitat in Figure 7 seems to correspond with an increase in cobble cover to at least 30 to 40% and higher. The denser cobble habitat also typically contains more homogenously sized cobble with fewer large boulders, although areas of large boulders were documented in this habitat. However, within the denser cobble areas, researchers were able to discern more refined habitat transitions than what the SSS could detect. An example of a finer resolution observation is being able to distinguish a 30-60 centimeter (12-24 in) size class of cobble habitat from a 60-90 centimeter (24- 36 in) size class.

Table 2. List of observed species.

	COMMON NAME	SPECIES	Nearshore	Offshore
FISH	Sand lance	<i>Ammodytes americanus</i>	X	
	Black sea bass	<i>Centropristes striatus</i>	X	X
	Little skate	<i>Leucoraja erinacea</i>	X	X
	Yellowtail damselfish	<i>Microspathodon</i> <i>chrysurus</i>	X	
	Striped sea bass	<i>Morone saxatilis</i>	X	
	Grubby sculpin	<i>Myoxocephalus aeneus</i>	X	
	Summer flounder	<i>Paralichthys dentatus</i>	X	
	Butterfish	<i>Peprilus triacanthus</i>	X	X
	Northern sea robin	<i>Prionotus carolinus</i>	X	
	Scup	<i>Stenotomus chrysops</i>	X	
	Northern pipefish	<i>Syngnathus fuscus</i>	X	
	Cunner	<i>Tautoglabrus</i> <i>adspersus</i>	X	X
INVERTEBRATES	Pink seapork	<i>Amaroucium</i> <i>pellucidum</i>	X	
	Common jingle shell	<i>Anomia simplex</i>	X	
	Sea star	<i>Asteria sp.</i>	X	X
	Stony coral	<i>Astrangia danae</i>	X	
	Northern comb jelly	<i>Bolinopsis infundibulum</i>	X	X
	Row encrusting tunicates	<i>Botrylloides sp.</i>	X	X
	Jonah crab	<i>Cancer borealis</i>	X	X
	Rock crab	<i>Cancer irroratus</i>	X	X
	Boring sponge	<i>Cliona celata</i>	X	X
	Slipper shell	<i>Crepidula fornicata</i>	X	X
	Lion's mane jelly	<i>Cyanea capillata</i>	X	X
	Encrusting white tunicate	<i>Didemnum sp.</i>	X	X
	White condominium tunicates	<i>Eudistoma sp.</i>	X	X
	Orange encrusting bryozoan	<i>Hippopodina feegeensis</i>	X	X
	Northern lobster	<i>Homerus americanus</i>	X	
	Toad crab	<i>Hyas araneus</i>	X	X
	Northern moon snail	<i>Lunacia heros</i>	X	
	Sea lace	<i>Membranipora</i> <i>membranacea</i>	X	
	Quahog	<i>Mercenaria mercenaria</i>	X	X
	Pink lumpy sponge	<i>Monanchora sp.</i>	X	X
	Hermit crab	<i>Pagurus sp.</i>	X	X
	Lobed moon snail	<i>Polinices duplicate</i>	X	
	Surf clam	<i>Spisula solidissima</i>	X	X
	Hydroids	<i>Unidentified</i>	X	X
	Jellyfish (pink center)	<i>Unidentified</i>	X	X
MACROALGAE	Hooked weed	<i>Bonnemaisonia</i> <i>hamifera</i>	X	X
	Irish moss	<i>Chondrus crispus</i>	X	X
	Green fleece	<i>Codium fragile</i>	X	
	Y-branched alga	<i>Dictyota sp.</i>	X	X
	Hooked red weed	<i>Hypnea musciformis</i>	X	X
	Pink segmented alga	<i>Jania rubens</i>	X	X
	Sea lettuce	<i>Ulva sp.</i>	X	X

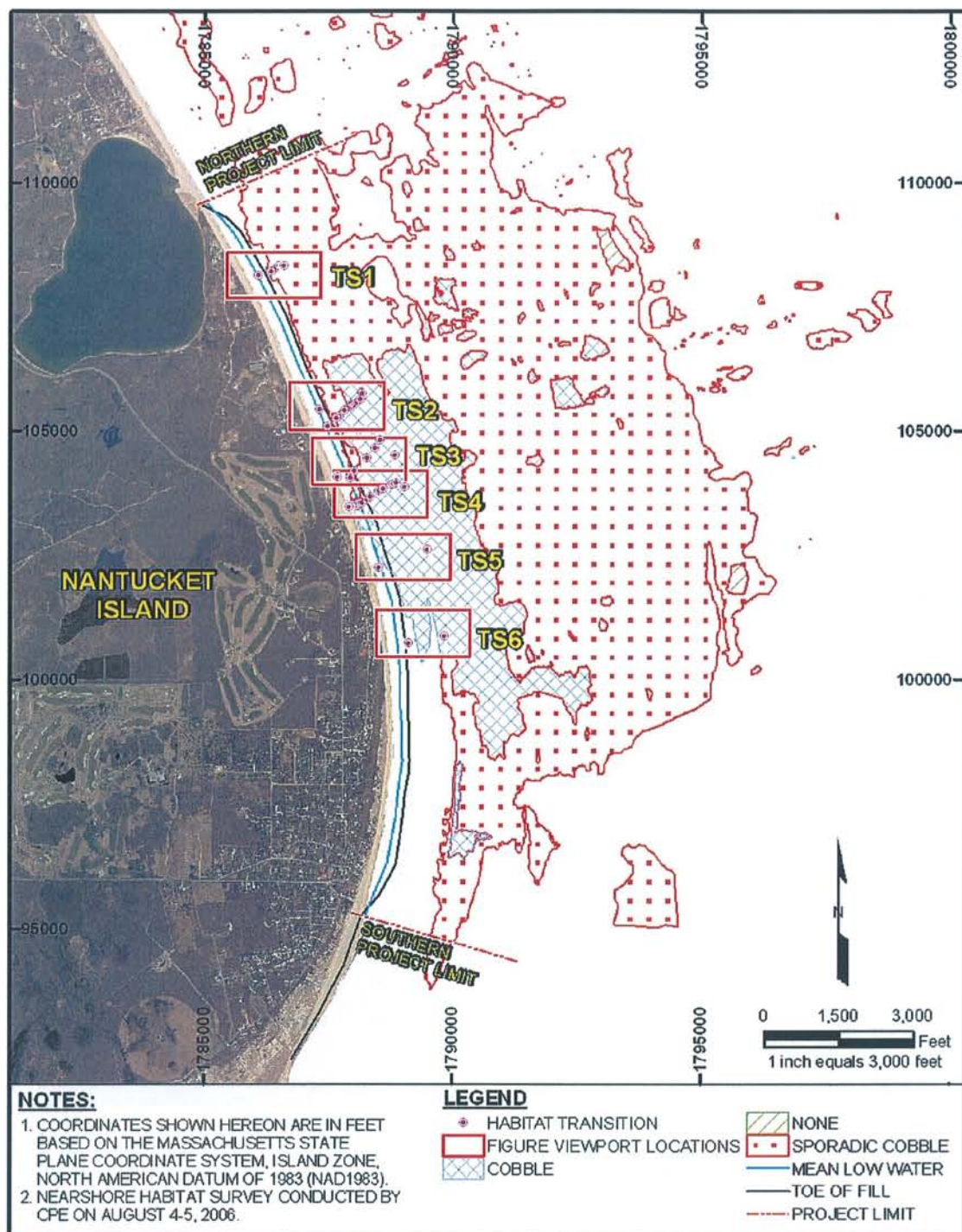


Figure 7a. Habitat transitions.

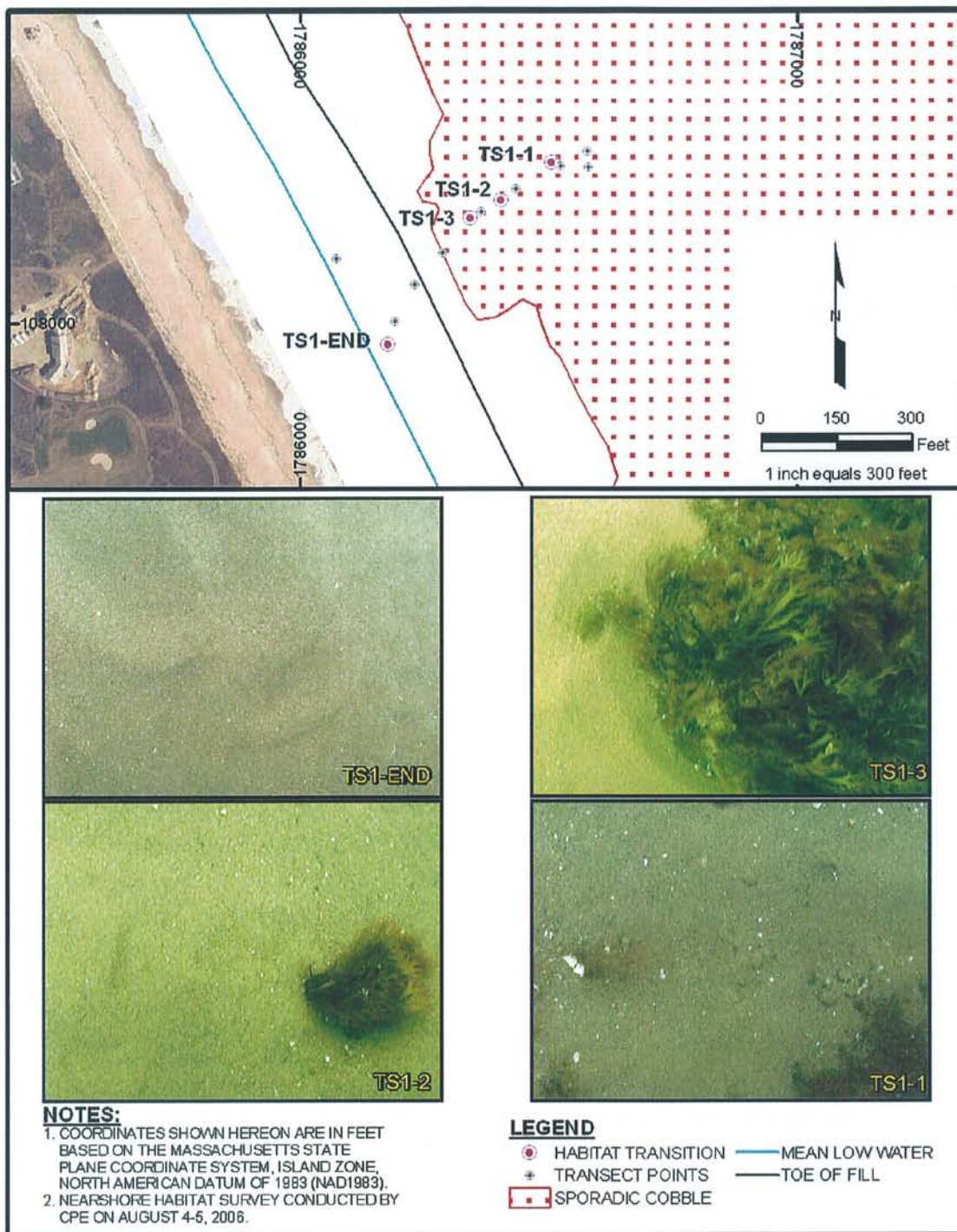


Figure 7b. Habitat transitions.

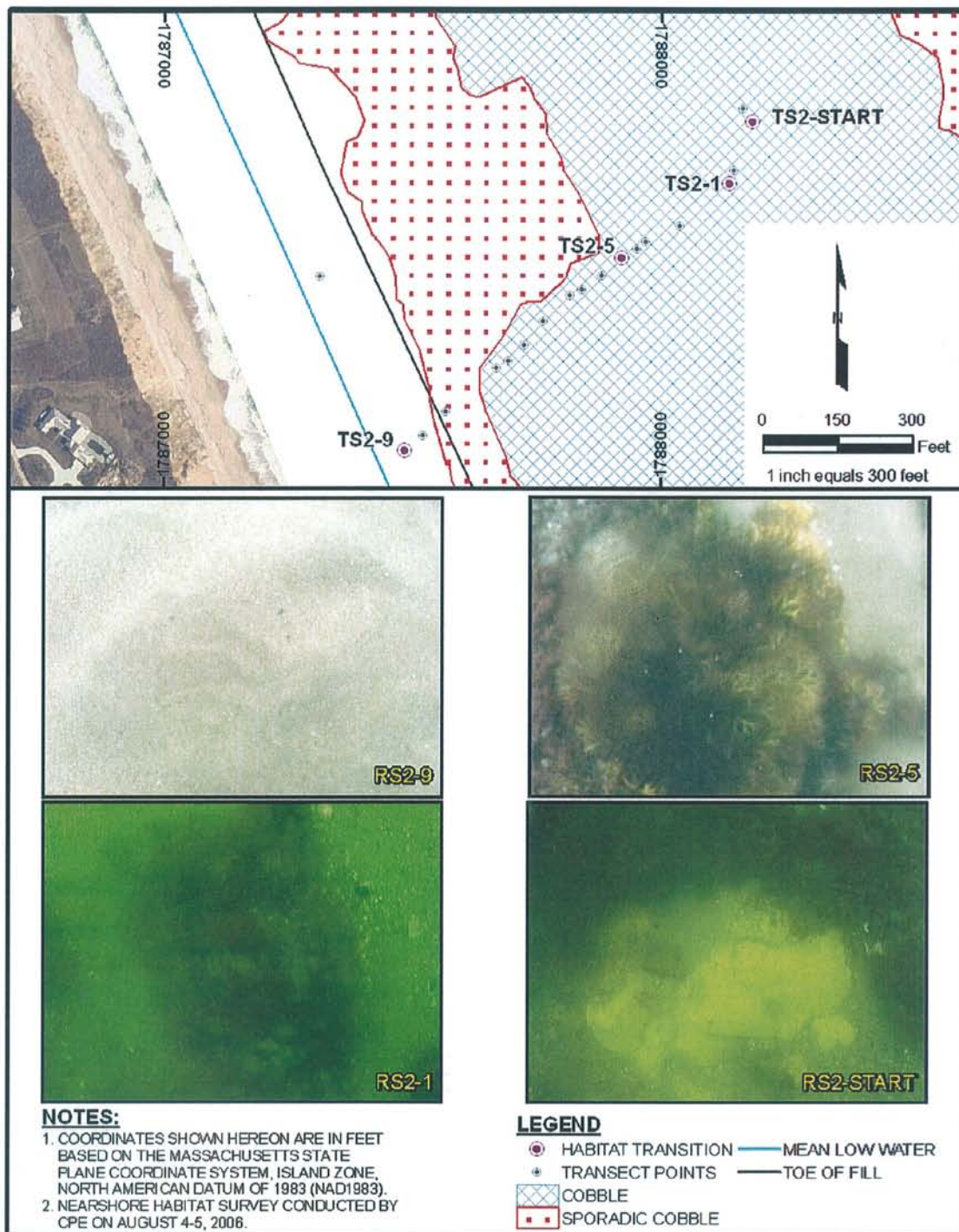


Figure 7c. Habitat transitions.

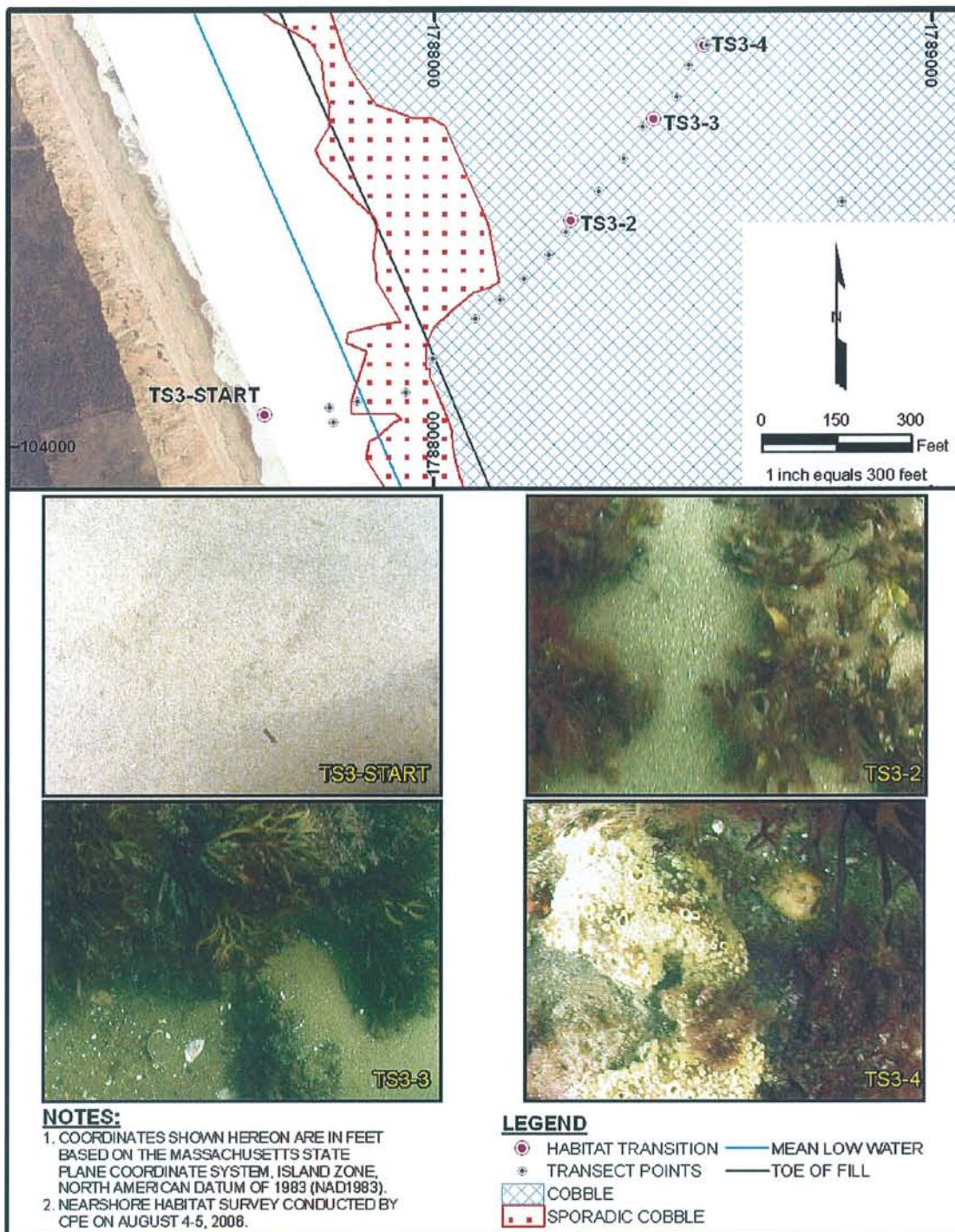


Figure 7d. Habitat transitions.

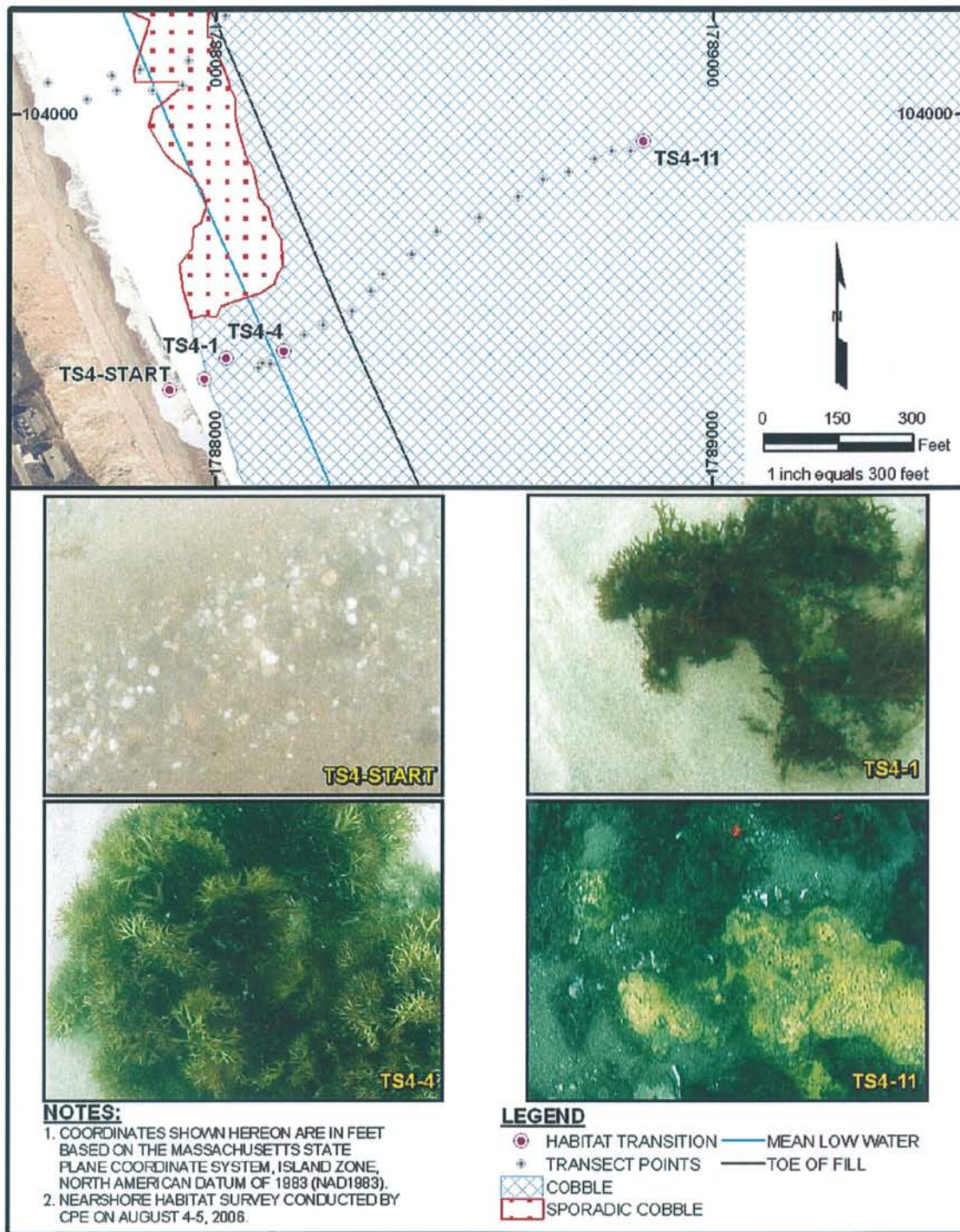


Figure 7e. Habitat transitions.

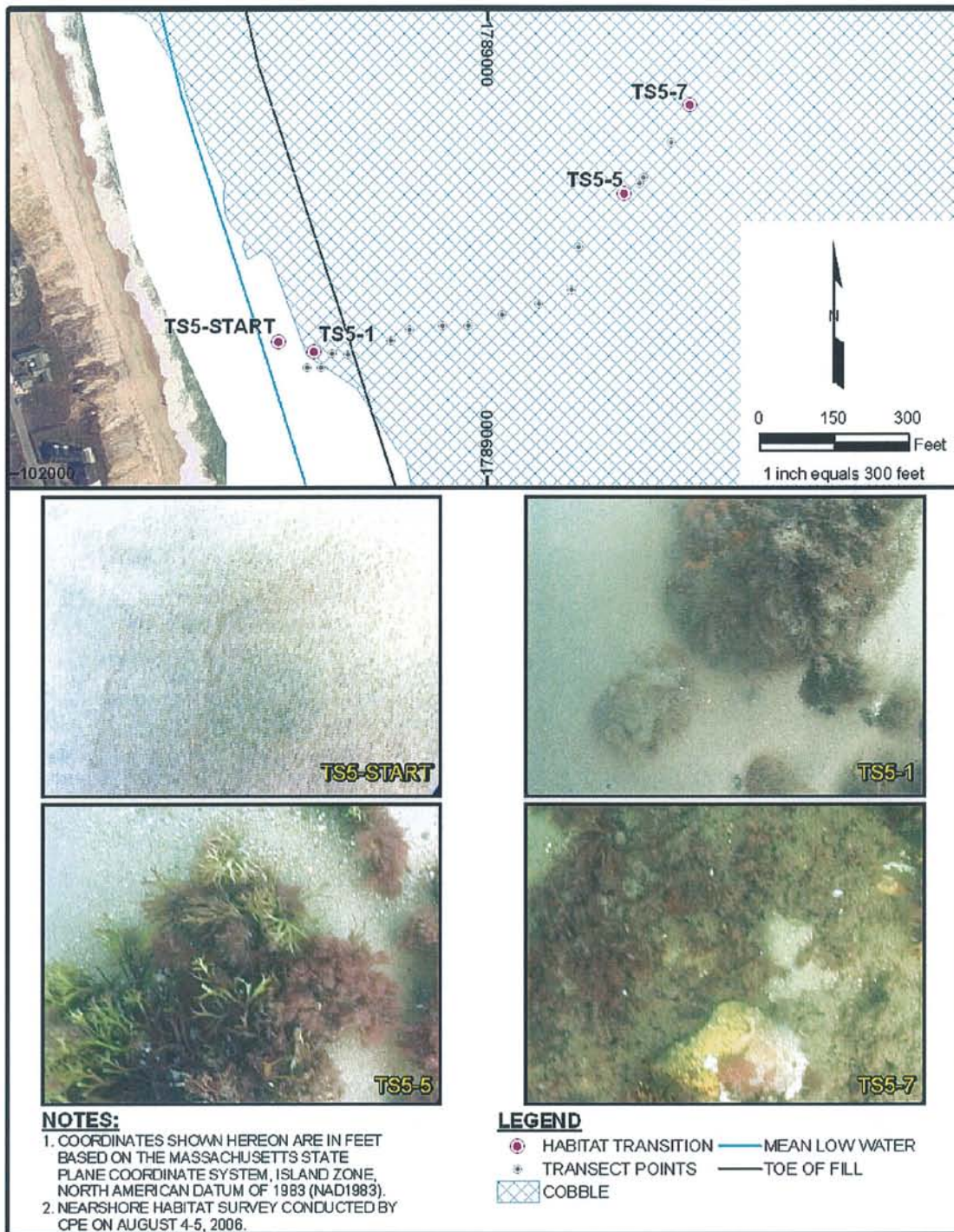


Figure 7f. Habitat transitions.

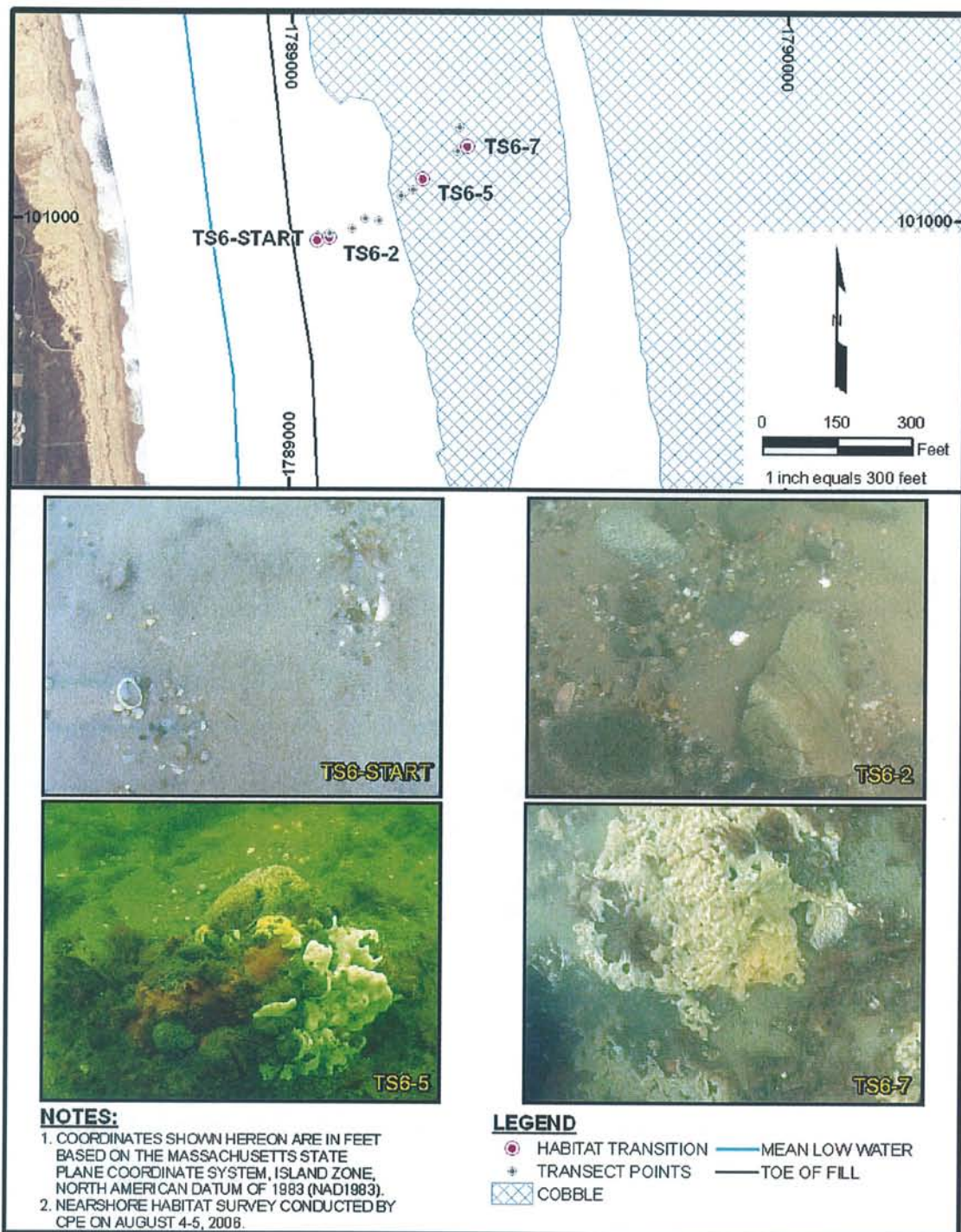


Figure 7g. Habitat transitions.

4.0 DISCUSSION

4.1 Habitat Type

The nearshore environment generally appears to transition from sand to sporadic cobble to more homogenous cobble offshore. Sporadic cobble areas appear to support a mix of both large boulders and smaller cobble. As the habitat transitions offshore, the cobble appears to become more homogenous in size and percent cover although some of the offshore sites had areas of large boulders and smaller cobble interspersed.

4.2 Biotic Trends

Based on the documentation conducted in August 2006, benthic cover appears to gradually transition from primarily macroalgae cover (*Chondrus crispus*) in the nearshore environment to a higher sponge cover by *Cliona celata* offshore. Larger boulders support a variety of sessile biota including various sponges and tunicates as well as macroalgae. Observed fish and invertebrate species are similar in both nearshore and offshore areas although the nearshore environment may be a preferred habitat for juvenile species, particularly black seabass. Larger boulders in the study area serve as habitat for large numbers of crustaceans and tend to attract larger fish than the smaller cobble.

4.3 Detecting Transitions

While subtle transitions in habitat were observable by the marine biologists, these transitions may not be as important to defining the quality of habitat as the initial transition from sporadic cobble to more homogenous cobble. In detecting habitat transitions using SSS, the sonar appears to detect general changes in the percent cover of homogeneously sized cobble rather than size of the cobble itself. Conversely, the SSS resolution does not appear to be fine enough to detect habitat transitions where cobble size is largely variable (i.e. areas with high percent cover of large boulders mixed with smaller cobble).

5.0 CONCLUSIONS

The results of these investigations concluded that cobble habitat is present offshore of the project area and was documented by both SSS and marine biologists. There are indications that the cobble habitat offshore of the project area may serve as a nursery for juvenile black seabass although other juvenile and adult fish species were observed utilizing the habitat. However, the quality and percent cover of cobble habitat within the Project area varies and is utilized to different degrees by different marine species. The sporadic cobble nearshore does not support the numbers of individual fish or the number of species that the denser, more homogenous cobble offshore supports. This should be taken into account when determining design alternatives and calculating project impacts.

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APPENDIX A. Photos of representative species observed in Project area.



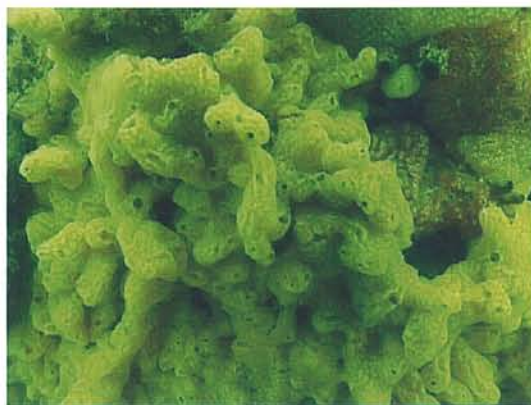
Northern stony coral (*Astrangia danae*)



Boring sponge (*Cliona celata*)



Seapork tunicate (*Amaroucium pellucidum*)



Invasive encrusting tunicate (*Didemnum* sp.)



Moon snail (*Lunacia heros*)



Sea star (*Asteria* sp.)



Northern lobster (*Homerus americanus*)



Jonah crab (*Cancer borealis*)



Hermit crab in sponge (*Pagurus* sp.)



Adult black sea bass (*Centropristes striatus*)



Juvenile summer flounder (*Paralichthys dentatus*);



Northern pipefish (*Syngnathus fuscus*)



Little skate (*Leucoraja erinacea*)



Cunner (*Tautoglabrus adspersus*)



Irish moss (*Chondrus crispus*)



Green fleece (*Codium fragile*)

Memorandum

Title: Revetment / Bluff Settlement Review

Project Number: 210019.1

Date: September 5, 2013

To: Epsilon Associates, Inc.

Copy: Azure Dee Sleicher, File

From: Marnel Daway

This memorandum addresses the potential vertical settlements induced by the placement of the proposed revetment on Sconset Beach. The primary purpose of the proposed revetment is to alleviate storm-induced erosion of Sconset Bluff.

1 Assumptions

The geometry of the proposed revetment was taken from Drawing No. 210019.1-3-10 (Proposed Section A-A at Lot 115) of the drawing set dated Aug. 14, 2013. The proposed revetment geometry is similar at the other cross sections and the analysis results are deemed applicable at the other locations.

The evaluation of vertical settlements is assumed to involve three coarse-grained soil types: riprap and filter layer of the proposed revetment and the coastal beach sand foundation. Coarse-grained soils are defined in ASTM D 2487 as particles coarser than the No. 200 (0.075 mm) sieve. The weight, strength and stiffness properties of the riprap and filter layer are assumed from unit weights of component stones and porosity estimates per the design requirements. Since the weight of the overlying revetment materials would be the cause of the settlement, and the revetment weight is actually maximum during low water conditions, the condition was modeled with a moist unit weight (γ) rather than as a submerged condition. If the revetment material is modeled as being submerged, then buoyant/effective weight, saturated minus unit weight of water ($\gamma_{\text{sat}} - \gamma_w$), would be used, reducing the overall weight. The saturated, but not submerged, condition yields an estimated settlement on the conservative side in terms of varying water levels.

Wave impacts can be modeled in Plaxis as a distributed surface load, but only a "permanent" vertical component of the load would actually cause settlement. Wave loads are usually considered transient. Wave loads were not modeled since they would not have any impact on the settlement.

Surficial samples taken of the coastal beach sand show grain sizes ranging from 0.62 to 0.91 mm and a 0.74-mm mean grain size with minimal silt and clay content (Epsilon Associates, 2006). This range of grain sizes can be classified as medium-sized per ASTM D 2487. From the geometry of existing slopes at the proposed revetment location (approximated as 1.5 horizontal to 1.0 vertical), it can be surmised that the sand is medium dense. The weight, strength and stiffness properties were then estimated for the coastal beach sand being medium dense and medium-sized.

For the analyses, the coastal beach sand was assumed to extend 80.0 ft below mean low water (MLW). Actual extent of the sand and underlying layers are unknown at this time. Groundwater was assumed to

correspond to mean sea level, 1.57 ft above MLW. The possible beneficial effect of the geotextile filter fabric was not considered.

2 Analyses

The geotechnical problem of determining vertical settlements on sloping ground does not lend itself well to hand calculations. A simple analytical model was then created from the proposed revetment geometry using Plaxis, with soil above +27.0 ft MLW modeled as distributed loading. Plaxis 2D is a software based on the finite element method and is intended for two-dimensional analysis of deformation and stability of soil structures and groundwater in general geotechnical engineering applications.

3 Results and Conclusions

Two conditions of the proposed revetment were analyzed in Plaxis: (a) with a sacrificial sand berm at the toe (Figure 1); and (b) without the berm (Figure 2). The maximum potential vertical settlement for both conditions is only about 0.6 inch, which is negligible compared to the amount of sand removed and the revetment material placed and unlikely to affect the function of the proposed revetment. Note that more vertical settlements could be expected if weaker soils are actually found within the assumed extent of coastal beach sand.

Since the materials assumed to be involved are coarse-grained, most of the vertical settlements would occur as the revetment material is being placed.

4 References

Ocean and Coastal Consultants, Inc. (Aug. 14, 2013). Drawing Set, Sconset Bluff Erosion Control Project.

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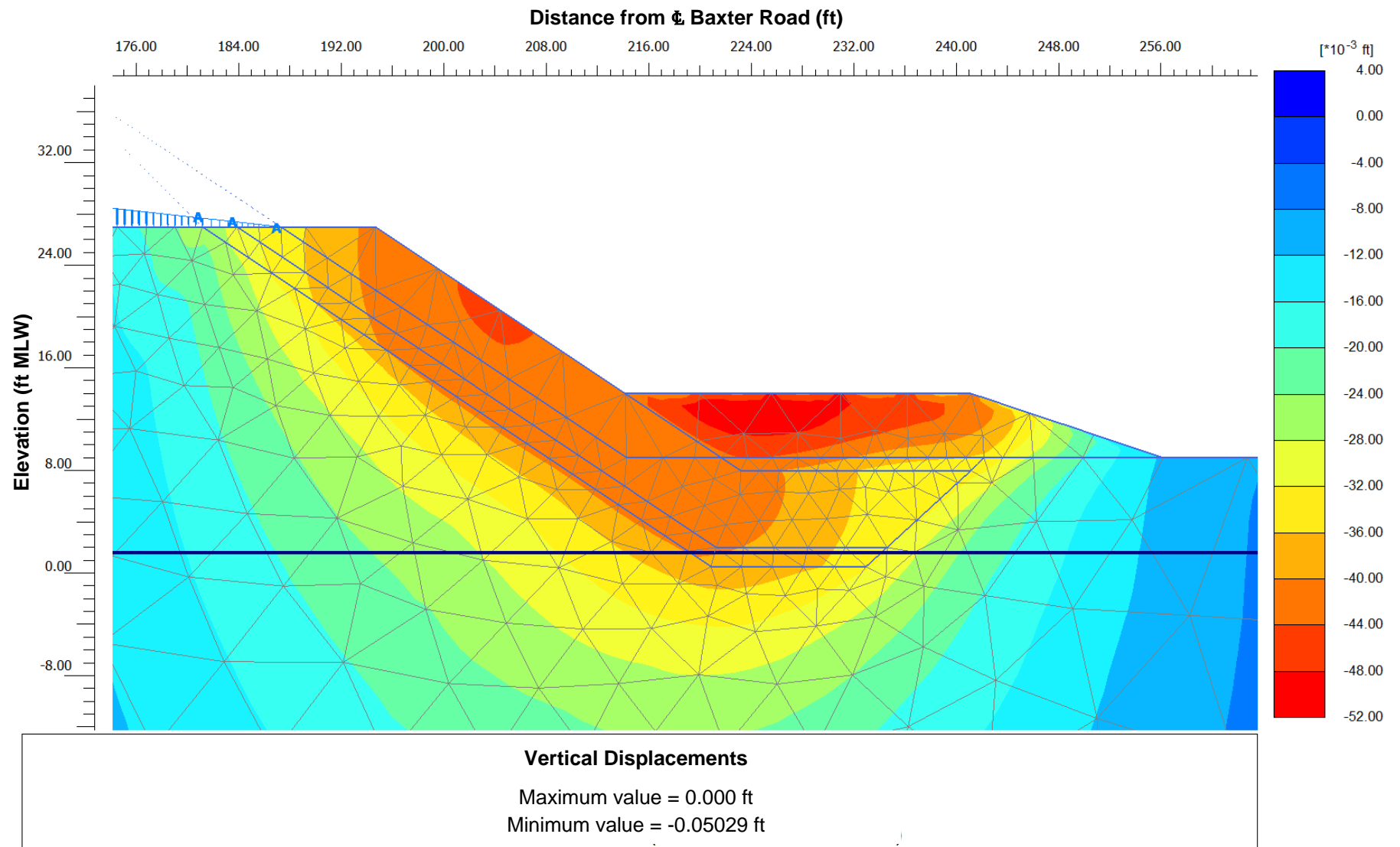


Figure 1. Plaxis results – Vertical settlements of proposed revetment with sacrificial berm at toe.

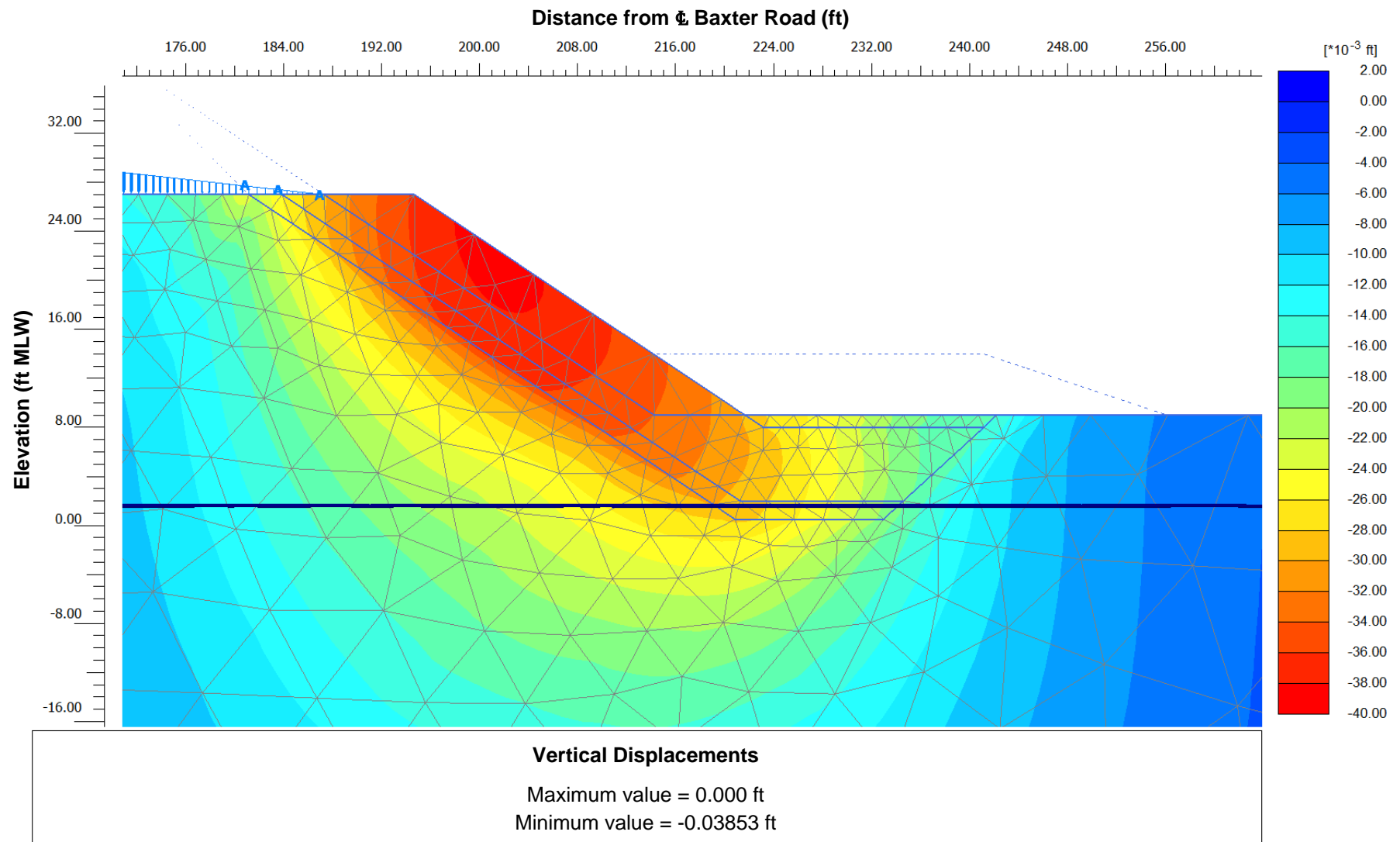


Figure 2. Plaxis results – Vertical settlements of proposed revetment without sacrificial berm at toe.

**BAXTER ROAD AND SCONSET BLUFF STORM DAMAGE PREVENTION PROJECT
NOTICE OF INTENT (DEP FILE NO. SE 048-2581)**

RESPONSES TO CZM LETTER DATED AUGUST 26, 2013

September 6, 2013

The following presents SBPF's responses to the letter from Ms. Rebecca Haney of the Massachusetts Office of Coastal Zone Management dated August 26, 2013. The comments and questions in the letter are presented in underlined text, followed by responses presented in indented text.

Provided the Commission and/or MassDEP find that the proposed revetment will prevent storm damage to buildings constructed prior to 1978 and the applicant has demonstrated that no method of protecting the buildings other than the proposed revetment is feasible, CZM would recommend the evaluation of the design considerations provided below in order to minimize and mitigate the potential adverse impacts of the proposed project on the eroding coastal bank, dunes, and beach.

The Applicant agrees with Ms. Haney about the circumstances under which a revetment shall be approved. The Project's Notice of Intent establishes that the revetment will prevent storm damage to buildings constructed prior to 1978 (see Section 4.1 of the NOI) and includes an Alternatives Analysis (see Attachment E to the NOI) that demonstrates that no method of protecting the buildings other than the proposed revetment is feasible.

Regarding Ms. Haney's suggested design considerations, the Applicant agrees with Ms. Haney on many of these suggestions and has already incorporated them into the Project design. Subsequent to the preparation of Ms. Haney's letter (for which she stated she reviewed the August 14, 2013 version of the plans), the revetment design has undergone a rigorous peer review by coastal engineer Dr. Michael Bruno, the Dean of the School of Engineering and Science at the Stevens Institute of Technology. This peer review led to several design changes included in the August 28, 2013 version of the plans; these design changes have addressed many of the concerns raised by Ms. Haney. The Applicant believes that the current design (reflected in the August 28, 2013 plans) provides a conservative, technically sound design that is responsive to comments received and that minimizes or mitigates impacts.

- 1) Locate the revetment as far landward as possible, overlapping onto the fronting coastal beach only to the extent necessary to achieve structural stability and the desired slope, to minimize reflection of waves onto the beach and adjacent resources and accommodate rising sea levels. Another consideration for the location of the structure is how uniform it is along the shoreline. If some sections of the structure stick out seaward of other sections (e.g., revetment section seaward of 77-81 Baxter Road), storm waves will likely focus on the sections of the structure sticking out causing increased erosion of the beaches fronting these areas.

The Applicant agrees with the suggestion in the first sentence to overlap the coastal beach only to the extent necessary to achieve structural stability and the desired slope. In an effort to be

responsive to concerns about the revetment design, and in accordance with guidance from Dr. Bruno, the slope was flattened from 1.5H:1V to 2H:1V which will minimize wave reflection onto the beach and adjacent resources. The revetment crest elevation was set at +27' MLW, which accounts for wave runup and rising sea levels. The revetment is located as far landward as possible without significantly undercutting the bank. The proposed overlapping on the coastal beach is the extent necessary for the Project to have the least overall impacts.

The Applicant also agrees with the suggestion in the second sentence to maintain a uniform revetment. The narrative submitted on August 23, 2013 and the revised plans submitted at the hearing on August 28, 2013 indicate that the bank will be smoothed between 77-81 Baxter Road to form a relatively straight revetment; therefore, the current design addresses Ms. Haney's concern.

- 2) Terminate the revetment at least 15-20' from neighboring property lines to reduce end effects of the structure on adjacent unarmored properties. This buffer will focus end effects primarily on the applicant's property. On the plans dated 8/14/13, the revetment extends approximately 40' south of the property line for 63 Baxter Road and over 180' north of the property line for 115 Baxter Road. There is an existing house on the lot just south of 63 Baxter Road that could receive significant adverse effects as a result of the proposed location of the structure.

The Applicant agrees with the need to minimize end effects on adjacent properties. This comment has already been addressed by the revised plans (dated August 28, 2013). The revetment will terminate on Lot 63 at the south end of the project site and Lot 119 on the north end. As shown on the August 28, 2013 plans, the ends of the revetment will be tapered back into the existing bank within the property lines of those lots to reduce impacts on adjacent properties.

- 3) Taper the ends of the revetment in elevation and slope to reduce the reflection of wave energy onto adjacent properties and resource areas.

This comment has already been addressed by the revised plans (dated August 28, 2013). As shown on the August 28, 2013 plans, both ends of the revetment will be tapered in elevation and slope back into the bank to reduce wave reflection and flanking on adjacent properties and resources.

- 4) Since rough-faced revetments dissipate more wave energy than smooth-faced structures, avoid the use of grout or other material in between rocks of the revetment to improve wave energy dissipation and minimize the potential for reflected wave energy.

The Applicant agrees with this suggestion, and this comment has already been addressed by the Project design. The sloping face of the revetment is proposed to have a rough surface. No grout or filling of voids is proposed. The 6' wide crest of the revetment will be a walkable passage by using relatively flat stones and filling voids with small stones. Since this elevation is above the wave runup elevation, it is expected that the crest will have no adverse impact on wave energy

dissipation or wave reflection.

- 5) To mitigate for the armoring of the bank and effectively eliminating a sediment source for the beach, compatible sediment needs to be added to the beach on a regular basis to ensure that the form and volume of the beach are not reduced as a result of the project. The minimum nourishment volume required is typically based on available information regarding the erosion history at the site. To determine the appropriate volume of sediment needed for mitigation, CZM recommends using all available information about historic shoreline erosion rates, including the Massachusetts Shoreline Change Project data available on CZM's website (www.mass.gov/eea/agendes/czm/program-areas/stormsmart-coasts/shoreline-change), and the quarterly beach profiles conducted for the SBPF. Both the long-and short-term rates of change need to be considered in light of the current shoreline conditions, the effects of recent storms, and whether the shoreline has fluctuated between erosion and accretion. The shoreline change project webpage has more information about interpreting the shoreline change rates. Based on the information submitted by the applicant, the Massachusetts Shoreline Change Project data, and an article by Wesley Tiffney, Jr. and Clifton Andrews, the cycle of erosion in the project area began in the mid-1970s. Therefore, it is most appropriate to use short-term shoreline change rates, which represent the rate of change from 1978 through 2009, rather than long-term shoreline change rates, which represent the change from 1846 through 2009. The proposed mitigation volume of 9.3 cubic yards per linear foot of beach per year seems low compared to the short term shoreline change rates, which range from 6-10' per year along the project area, which is approximately equivalent to 15-26 cubic yards per linear foot of beach per year.

While the Applicant agrees with Ms. Haney on the need for mitigation, Ms. Haney's statements do not take into account the coastal setting at Sconset and do not seem to include all relevant CZM data. These deficiencies are addressed below.

- 1. Shoreline change is not a suitable proxy for coastal bank retreat given the coastal setting at Sconset. The mitigation volume is best determined using actual bank retreat rates.**

Ms. Haney's suggestion to utilize short-term shoreline change rates from 1978-2009 to estimate the volume of sediment eroded from the coastal bank fails to consider the coastal setting at Sconset and, by doing so, recommends the use of irrelevant data. The Sconset shoreline and beyond (from the Sewer Beds at the south to Wauwinet at the north) have been carefully monitored on a quarterly or semi-annual basis for nearly twenty years, yielding an impressive record of highly-accurate data. This monitoring has consistently shown that shoreline erosion rates in areas where the coastal bank is fronted by dunes are *significantly higher* than shoreline rates in areas with an eroding coastal bank. (This observation is as expected, since an eroding dune contributes less to the littoral system than an eroding bank.) In other words, survey data show that the shoreline change rates in areas fronted by dunes are *not representative* of the coastal bank retreat rate. Rather, the shoreline change rate and coastal bank retreat rate may

only begin to approximate one another after the coastal dune and any vegetated portion of the coastal bank have completely eroded and sufficient time has passed for an equilibrium to be reached. The coastal dune in the Project area was still present during much of the 1978-2009 time period; therefore, Ms. Haney's suggestion to use a 1978-2009 shoreline change rate to approximate coastal bank retreat is untenable.

Rather than trying to approximate bank retreat using unrelated shoreline change data, "Best Practices" is to use the actual bank retreat. We have utilized the best available data (orthorectified, high-resolution aerial photographs, LiDAR data, and current section views of the Project site) to develop a long-term bank retreat rate and associated volume. Our methodology and conclusions are provided in detail in the document entitled: "Supplemental Responses to Questions From Nantucket Conservation Commission Asked at Public Hearing" dated August 23, 2013. This analysis yields a bank contribution rate of **12.0 cy/lf/yr**.

Finally, as part of our bank retreat analysis included in the above-referenced August 23, 2013 submission, we compared shoreline change rates to bank retreat rates, but, importantly, we only did this comparison for those areas where the coastal bank had been retreating throughout the entire review period. The coastal bank was actively retreating from 1994-2013 in the area from 91 to 119 Baxter Road. Therefore, we compared the 1994-2013 bank retreat rate from 91-119 Baxter Road (3.2 ft/yr) to the 1994-2013 shoreline change rate for those profiles located nearest to 91-119 Baxter Road (3.1 ft/yr). The similarity between these two numbers (3.2 ft/yr for bank retreat rate and 3.1 ft/yr for shoreline change rate) supports the accuracy of the calculated bank retreat rate. Comparisons between 1994-2013 shoreline change rates and bank retreat rates were not made for areas farther south of 91 Baxter Road, since the coastal bank was not fully devoid of vegetation throughout this time period.

2. The cited CZM shoreline change data are incomplete.

While we have explained above why the 1978-2009 shoreline change data cannot be used as a proxy for bank retreat, there are several incomplete statements in the data Ms. Haney cites that we wish to address.

Ms. Haney quotes a shoreline change rate of 6 to 10 feet/yr from 1978-2009 in the "project area," but this analysis apparently overlooks the northern section of the project. The CZM shoreline change data for the Project area (63-119 Baxter Road; CZM transects 285 through 306) indicates somewhat lower shoreline change rates, in the range of 4 to 9.7 feet/yr, and even these rates are inapplicable given that they reflect dune erosion, not bank erosion, in the earlier years. Additionally, the CZM data is subject to uncertainty; such uncertainty is inherent to the methodology of identifying a shoreline from aerial photographs used for the broad-reaching CZM shoreline change data project. Although CZM quantifies this uncertainty for each transect; Ms. Haney

fails to acknowledge this uncertainty, even though the average uncertainty for the transects in the Project area is almost 3 feet. By contrast, the 1994-2013 shoreline change data we cite in our analysis is based on highly accurate, site-specific on-the-ground survey data.

Ultimately, we have provided a rigorous and defensible calculation of the average bank retreat rate and associated volume. Our analysis is supported by surveyed shoreline change data (when shoreline change data are chosen from a period when the coastal bank is actively retreating). As we describe above, Ms. Haney's analysis does not consider the coastal setting at Sconset and therefore is misdirected.

- 6) The volume of sediment required to mitigate for armoring the bank would be in addition to that necessary to mitigate for increased erosion of the fronting and adjacent beaches and banks. CZM recommends that the Commission consider the increased erosion of the fronting beach and adjacent banks observed with the various erosion control projects along this site to inform your decision about a minimum amount of pro-active nourishment to mitigate for these impacts. It is very likely the volume will need to be modified based on beach profile monitoring, but it is important to recognize the need for including this as part of the project.

The Baxter Road and Sconset Bluff Storm Damage Prevention Project intends to follow the state standard of "Best Available Measure," which is to provide to the littoral system, on an annual basis, the average amount of sand that would have been provided by the eroding bank absent the project. This amount has been historically required by the Nantucket Conservation Commission and DEP. Further, we reached out to CZM and DEP at the outset of this Project to confirm this standard, and this was the agreed-upon approach.

Regarding the concern for end scour, the Project has already implemented several means whereby end scour and flanking will be prevented or mitigated. First, the sacrificial sand will be placed within the revetment project area and it will extend approximately 300 feet at revetment ends to help prevent end scour. Second, the revetment ends will be tapered (and covered with sand mitigation) to prevent flanking and end scour. Finally, these areas will be monitored to determine if flanking is occurring and if so, mitigative sand will be applied to remedy the problem.

Finally, the Project intends to implement a monitoring and mitigation plan that will allow for identification of any potential impacts and the placement of an additional volume of sand mitigation, if required. A Proposed Sand Mitigation Plan and Monitoring System has been submitted to the Commission.

- 7) Given the limited supply of on-island sediment for nourishment, the logistical complexities associated with placing sediment on the beach, and the additional complications in placing sediment on the beach as it narrows seaward of the revetment, CZM recommends that all the components of mitigation be factored into the Commission's review of the project.

The Applicant has demonstrated that there is over a 20-year supply of sediment for nourishment on the island (or even more, since new pits open periodically), and that even if island pits run out of sand, additional sediment could be brought in by barge. Since the cost of sand on the Island is set based on the cost to deliver sand from off-island, the use of off-island sand would not change the cost associated with this element of the Project (see “Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on July 24, 2013”). The Applicant has also explained the Project’s flexible and innovative sediment delivery system, such that sand can be placed on the beach even under successive storm conditions (see “Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 8, 2013” dated August 15, 2013, and SBPF Presentation from 8-28-13). There is no issue with the constructability and maintenance of the mitigation sediment component of the Project.

- 8) The applicant submitted a chart summarizing grain size data for 24 sediment samples taken along eight shore-perpendicular transects within the project area. CZM recommends that the grain size data for each sediment sample be provided to the Commission to inform determination of the appropriate grain size for beach nourishment.

The Applicant has provided a rigorous assessment of the compatibility of the proposed island pit sources to the native bank sediment. Grain size compatibility between the proposed borrow sites (Reis and/or Holdgate pits) and the coastal bank and coastal beach was assessed using both a comparison of grain sizes and the Overfill Factor analysis. A comparison of mean grain sizes between samples from both pits and Sconset bluff and beach indicates that both proposed pit sources are bank- and beach-compatible sediments. (See “Responses to Comment Letters from Milone & MacBroom dated August 2, 2013,” and attachments, dated August 23, 2013).

Sediment compatibility between the island pits and native coastal bank is further demonstrated by the Overfill Factor analysis. The Overfill Factor calculation is the approach that is cited in MassDEP’s guidance document for Best Management Practices for Beach Nourishment Projects (MassDEP (2007)).¹ This approach is also described in the Shore Protection Manual (USACE, 1985)².

The Overfill Factor (R_A) was developed by James (1975)³ and estimates the stability of borrow site sediment on the beach under the assumption that the existing beach sediment is stable. The result is a factor that predicts the percentage of sediment that may be lost, since part of the grain size population may be finer sands. The resulting factor suggests how much sediment

¹ MassDEP, 2007. Beach Nourishment: MassDEP’s Guide to Best Management Practices for Projects in Massachusetts. 31 pages.

² U.S. Army Corps of Engineers (USACE), 1984. Shore Protection Manual, 4th edition, 2-part set, U.S. Government Printing Office, Wash., D.C.

³ James, J.R. 1975. *Techniques in Evaluating Suitability of Borrow Material for Beach Nourishment*. Technical Memorandum No. 60, Coastal Engineering Research Center, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

should be placed on the beach to provide the equivalent of one cubic meter of sediment. This factor requires calculation of the mean grain size and sorting for the borrow source and the "beach" (in this case, the bank since the mitigation sediment is meant to replicate the volume of sediment contributed from the coastal bank). The borrow site to "beach" sorting ratio is then compared the mean diameter of the grain size distribution for the borrow source minus the mean for the "beach" divided by the sorting for the borrow site.

The Overfill Factor Analysis for the coastal bank indicates that to replicate the amount of beach-compatible sediment eroded from the coastal bank, **no overfill factor is required** when using either the Reis or Holdgate pit. (See "Responses to Comment Letters from Milone & MacBroom dated August 2, 2013," and attachments, dated August 23, 2013 and letter from Peter Rosen, dated September 4, 2013.)

- 9) Additional beach profiles may be needed at the ends of the proposed structures to fully assess the impacts associated with the Phase one revetments as well as the longer Phase two project. Because of the complex sediment transport patterns in this area, it has been difficult to differentiate the impacts of various shore protection projects along the Sconset shoreline from the natural changes in the system based on beach profiling conducted for the SBPF. CZM recommends that the Town and the applicant consider using an independent third party to conduct the monitoring, analyze the data, and provide recommendations for mitigation volumes based on that analysis. CZM also recommends that clear thresholds be established to determine when additional mitigation will be needed.

The Applicant agrees with CZM that additional shoreline transects may be needed at the ends of the revetment. The Applicant also agrees with CZM on the need for a clear protocol for sand monitoring and mitigation. These details are presented in a separate monitoring and mitigation plan submitted to the Commission titled: "Proposed Sand Mitigation and Monitoring System."

- 10) Due to the exposed nature of the project site and relatively narrow dry beach, there have been significant logistical challenges with the installation and maintenance of various shore protection projects along the project area in the past. These challenging conditions have resulted in unanticipated impacts during construction. For example, when components of the beach dewatering system were being installed in 1994, large sand-filled tubes were needed to provide a buffer from daily tides and waves so the beach dewatering system could be installed. In 2005, when the beach had narrowed even further, steel sheathing was needed to establish dry workspace for installation of the upgraded beach dewatering system. The interaction of the waves with the steel sheathing eroded the beach in front of the sheathing and there was additional erosion of the beach created by runoff from dewatering the work space (photographs available). Although the information submitted by the applicant to date contains some information on the construction methodology, CZM recommends that additional detail be provided to facilitate the Commission's review of the potential adverse impacts that may occur during construction and any mitigation that might be necessary for the short-term impacts.

The Applicant has already provided significant information on the Project's construction, expected impacts, and proposed mitigation measures. See "Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 8, 2013" dated August 15, 2013, and SBPF Presentations from 7-31-13 and 8-28-13. This previously-submitted information has demonstrated that there are no issues with the constructability and maintenance of the Project, and that measures have been put in place to minimize or mitigate impacts (such as using a barge to deliver most of the revetment supplies, maintaining the ability to deliver sand even in the event of successive storms, refueling as far landward of resource areas as possible, providing a roadway bond, avoiding impacts to offshore resource areas during barge landing, etc.).

**BAXTER ROAD AND SCONSET BLUFF STORM DAMAGE PREVENTION PROJECT
NOTICE OF INTENT (DEP FILE NO. SE 048-2581)**

**RESPONSES TO COMMENT LETTER FROM APPLIED COASTAL RESEARCH AND
ENGINEERING DATED AUGUST 28, 2013**

September 6, 2013

The following presents SBPF's responses to comments and questions presented by the Nantucket Land Council (NLC) consultant, Applied Coastal Research and Engineering, Inc. (Applied Coastal), in their memorandum dated August 28, 2013. The comments and questions in the letter are presented in underlined text, followed by responses presented in indented text.

Thoughtful and in-depth coastal science and engineering calculations should be required to support any proposed project of this scale, since the potential impacts of the proposed armoring could be substantial (both temporally and spatially), as well as irreversible. To date, many of Applied Coastal's comments have focused upon the inadequacies of proposed mitigation efforts; however, the range of concerns regarding the 'hard' armoring of the bluff extend well beyond potential mitigation requirements. Similar to past proposals by SBPF, design details, construction protocol, future mitigation, and monitoring details/additional mitigation trigger conditions all remain unclear. Substantial design changes continue to be made, even though the applicant has claimed numerous times through the hearing process that the information in the original application represents the 'best available measure'. The latest design changes increase the foot-print of the structure on the beach substantially due to the gentler slopes and newly proposed toe design. This reduces the narrow beach by at least an additional 2 acres. The structure design should be evolving to minimize impacts and footprint while protecting the bank, not the opposite.

Applied Coastal's complaint that the Project design has changed in response to comments from the Conservation Commission and recommendations from a rigorous peer review by Dr. Michael Bruno (coastal engineer and Dean of the School of Engineering and Science at the Stevens Institute of Technology) is untenable. It would seem absurd to ignore the concerns of the Commission and the design guidance from a respected and recognized authority such as Dr. Bruno simply to avoid changing a project design, and we find it hard to believe that Applied Coastal would stand behind this recommendation.

Likewise, Applied Coastal's general complaint that the Project's "design details, construction protocol, future mitigation, and monitoring details/additional mitigation trigger conditions" are "unclear" completely ignores the substantial volume of information that has already been provided. The Project's design and details are included in the August 28, 2013 version of the plans, "Supplemental Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 8, 2013" dated August 23, 2013, and "Responses to Comment

Letters from Milone & MacBroom Dated August 2, 2013” dated August 23, 2013. Construction information has been provided in “Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 8, 2013” dated August 15, 2013; “Supplemental Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 8, 2013” dated August 23, 2013; and SBPF Presentations from 7-31-13 and 8-28-13. A Proposed Sand Mitigation Plan and Monitoring System has been submitted to the Commission.

1. Adequate baseline engineering and coastal processes analyses have not been provided by SBPF to support a coastal engineering project of this magnitude. As of the August 23 submittal by Epsilon Associates, Inc, the applicant has not provided a quantitative assessment of sediment transport this is essential for the understanding of the system in which the structure is being proposed. In the absence of a quantitative assessment of the littoral system, the Applicant has substantially redesigned the proposed revetment structure increasing impacts, serious questions and concerns regarding the validity of the proposed mitigation plan and requirements, a lack of an adequate monitoring plan, and more importantly no qualitative or quantitative assessment of the potential impacts the proposed armoring will have on adjacent shorelines. Damage to adjacent shorelines is likely to be irreversible, and cannot be addressed with promises made regarding future mitigation. Mitigation protocols and plans must be fully developed prior to the issuance of a permit and well in advance of any construction activities.

This comment simply repeats previous comments. SBPF previously addressed the comment regarding littoral drift in “Supplemental Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 8, 2013” dated August 23, 2013, and during verbal testimony on August 28, 2013. Additional information on the sediment budget is provided in “Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 28, 2013” dated September 6, 2013. Finally, as noted above, a Proposed Sand Mitigation Plan and Monitoring System has been submitted to the Commission.

2. The August 23rd submittal includes an update of the bluff retreat rates utilizing LIDAR data collect in July of 2013. The inclusion of the latest bluff profiles should have been completed prior to the original NOI submission since the previous submissions excluded the significant erosion events which occurred during the fall and winter of 2012 and 2013.

Applied Coastal’s complaint about the timing of the LiDAR data is irrelevant to the Conservation Commission review process and ignores the fact that significant effort was expended to obtain the 2013 LiDAR data as expeditiously as possible. Under the MOU with the BOS, SBPF was required to file a NOI in early July, given the serious and imminent threat to Baxter Road and the need for protection prior to the winter. The LiDAR survey was conducted and processed as soon as was possible, given that the timing of the LiDAR survey is dependent upon several factors, including the weather.

There are a number of shortcomings with the mitigation plan as currently proposed;

- The current mitigation plan ignores the contribution the beach provides to the littoral system (which was included in a previous submittal's mitigation plan), nor does it account for that lost volume of available sediment due to the covering of the beach by the revetment and eventual narrowing and loss of beach due to armoring. The previous proposal included 6.8 cubic yards per linear ft per year as the nearshore and beach component of the mitigation that would help maintain the stability of the Town-owned beach fronting the structure. No reason has been provided as to why SBPF has removed this mitigation volume from their mitigation plan. Overall, the existing proposal still represents less than 50% of the mitigation rate that was proposed in 2012 for a similar project by the same coastal geologist and engineer.

This comment has been addressed repeatedly, both at the hearings by verbal testimony and in written submissions (see "Responses to Comment Letters from Nantucket Land Council and Applied Coastal Research and Engineering Dated July 30, 2013" dated August 6, 2013).

- The characterization of the sediment from the coastal bank and beach provided in the August 23 submittal and previous SBPF filings does not take into account the changing sediment characteristics of the bank and beach over time. The October 20, 2011 letter from Dr. Rosen illustrates that from 2001 to 2006, the material supplied by the coastal bank coarsened, and from 1998 to 2006 the beach sediment coarsened. In the written response to Milone & MacBroom, Epsilon Associates, Inc, state that the Overfill Factor analysis indicates that no overfill factor is required when using either Reis or Holdgate Pits. However, that analysis used time averaged composite samples for the bank and beach, which when averaged overtime reduces the mean grain size of the native sediment being supplied by the bank and beach. The time averaging of the sediment samples skews the results from the Overfill Analysis to support the claim that no additional material is required to replicate the native bank and beach material. This approach clearly ignores the changing sediment characteristics of the bank and beach and should be reevaluated and corrected to reflect current sediment characteristics.

The Applicant is required to replicate the amount of sand that would have eroded from the coastal bank absent the Project; therefore, the below discussion focuses on the coastal bank.

The reported bank grain size characteristics in the October 20, 2011 letter from Dr. Peter Rosen (reproduced below) are all in the range of 1-2 phi, which corresponds to medium sand. While some variability is expected in a sand deposit of this size, what is more remarkable is the consistency between samples (all are medium sand) from different years.

2001: 2 phi, (medium - fine sand) includes 8% mud
2003: 1.8 phi (medium sand) includes 5.5% pebbles or granules
2006: 1.2 phi¹ (medium sand) includes minor fine pebbles/granules

To add a measure of conservatism to the Overfill Factor Analysis, the Overfill Factor calculation was rerun using only the 2006 data (the coarsest data), and the 2006 data were refined to include data from those sampling transects within the revetment project area. The mean grain size for the 2006 data from the revetment project area is 1.34 phi. This analysis, included in the attached memo from Dr. Peter Rosen dated September 4, 2013, again demonstrated that **no overfill factor is required** when using either the Reis or Holdgate pits.

- The updated bluff erosion rates for the crest of the coastal bank from Lot #91 to #119 show the bank has eroded an average of 3.2 feet per year from 1994 to 2013. It would also be useful to characterize the erosion of the coastal bank from Lot #91 to #119 over the period 2003 to 2013. This would illustrate the consistency of the measured erosion rates over different time periods and more critically illustrate whether the retreat rates are accelerating or decelerating. The additional time period would also provide a comparison of the erosion rates between the northern and southern sections of the proposed project. The latest bank surveys provided as part of this NOI, suggest that the bank erosion rates are accelerating and therefore providing more sediment to the littoral system. It is critical that accurate erosion rates be utilized during the formation of a mitigation plan to minimize downdrift impacts and narrowing of fronting beach.

The calculated bank retreat data from 91-119 Baxter Road are based upon using the best available data to determine a long-term, average bank retreat rate. If anything, the significant erosion during the 2012-2013 winter has skewed the average value upwards. While the 2012-2013 winter included catastrophic bank erosion, we disagree that this single year of significant erosion means bank retreat rates are accelerating.

- In the absence of a quantitative assessment of sediment transport that examines the true downdrift impacts on neighboring shorelines, the ends of the proposed revetment should be tapered in width and height over the last two or three lots on the northern and southern ends of the proposed project. The tapering of the structural footprint will help to minimize and reduce end effects associated with the armoring of the coastal bank and beach. The loss of downdrift coastal bank due to end effect scour cannot be mitigated or repaired in the future and must be minimized as part of the planning and design of the project. It is critical that the applicant provide additional technical support to address the influence of the structure on sediment transport and address the proposed mitigation

¹ There was a typo in the October 20, 2011 letter, where the 2006 grain size was reported in mm (0.45) instead of phi (1.2).

shortcomings.

This comment has already been addressed. The revised plans submitted on August 28, 2013 show that the revetment ends will be tapered.

3. The Applicant has stated that additional transects would be added to the Shoreline Monitoring Plan, however a revised plan has not been submitted. The revised monitoring plan should include additional transects on regular intervals (50-100 foot intervals) immediately updrift and downdrift of the proposed project to monitor the project for end effects and increased erosion along the adjacent shoreline and coastal bank. The monitoring survey should be conducted pre- and post- nourishments to allow for quantification of shoreline variations and movements after the revetment is constructed. This near-field monitoring is critical to ensure that the structures are not having adverse impacts on adjacent properties due to 'end effects'.

A Proposed Sand Mitigation Plan and Monitoring System has been submitted to the Commission and includes additional transects near the ends of the revetment.

Overall, a mitigation plan should be conservative with monitoring used to reduce volume, if deemed appropriate in the future. The current plan does not adequately assess or address the impact of armoring 3,400 feet of coastal bluff and beach along a shoreline that is retreating in excess of 5 feet per year. Numerous statements have been made about other structures being located in similar wave and storm environments, however none of those structures are located on a coastline that is retreating in excess of 5 feet per year. Additionally, no information regarding the long-term impact on downdrift beaches as a result of revetment construction been shown. The erosion rates along the Sconset shoreline create unique design circumstances, which must be accurately reflected in the formulation of appropriate mitigation volumes, measures, monitoring plans, and more importantly coastal engineering design measures and compromises if the project is to succeed.

This statement simply repeats previous comments. The comments related mitigation plan and the dynamic nature of the Sconset shoreline are addressed above and in: "Proposed Sand Mitigation Plan and Monitoring System" dated September 6, 2013; and "Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on August 28, 2013" dated September 6, 2013.

We disagree with the comment related to the lack of structures being located in similar environments and we have repeatedly addressed this comment. See "Responses to Questions from Nantucket Conservation Commission Asked at Public Hearing on July 24, 2013;" "Responses to Comment Letters from Nantucket Land Council and Applied Coastal Research and Engineering Dated July 30, 2013" dated August 6, 2013; and SBPF Presentations dated July 31, 2013 and August 8, 2013.

GEO/PLAN ASSOCIATES

30 MANN STREET
HINGHAM, MASSACHUSETTS 02043-1316
Voice & Fax: (781) 740-1340
Email: geoplanassoc@gmail.com

September 4, 2013

Ms. Maria Hartnett
Epsilon Associates
3 Clocktower Place
Suite 260
Maynard, MA

Re: Evaluation of borrow area sand relative to natural coastal bank sand

Dear Ms. Hartnett:

I have evaluated the suitability of sand from two sand pits on Nantucket, Holdgate and Reis, for use to replace natural nourishment of beach sand from a portion of coastal bank on Baxter Road, Sconset, where a revetment is proposed.

I am using the same composite sand analysis for the two sand pits as I have used in previous evaluations (January 17, 2012). The coastal bank data is derived from the 2006 detailed sampling of the coastal bank by CP&E. The samples within the revetment area were combined to create a composite statistics.

These data are evaluated using the method of James (1974) to estimate the Overfill Factor (R_A), which estimates the additional amount of borrow area sand required to be equal to a given volume of beach sand. In this analysis, I compared the sand pit sand to the natural bank sand, and the result estimates how much additional sand, if any, is necessary to equal a volume of natural coastal bank feeding the adjacent beach.

I also reviewed earlier coastal bank samples in this area and noted that these composite samples were finer than the 2006 data. Therefore, 2006 is a worst-case of all the data available, and therefore yields a conservative estimate.

The attached diagram shows that the Overfill Factor for both sand sources is 1, in the range described by James as "Stable." This means that one cubic yard of sand from the pit is equivalent to one cubic yard of sand from the coastal bank.

This is not surprising, since in this setting the sand pits and the coastal bank are the same geological unit (glacial outwash) sampled in different locations.

I understand that there is some concern that the coastal bank sand is coarsening over time. Both from my evaluation of the sediment data, and my personal knowledge of that coastal bank over several decades, I do not believe that this is a trend of the bank deposits. There is a good deal of natural variation of the sand in a deposit of this size, even at a given time. However, the sediment throughout the bank and the outwash deposit in general, including the 1998, 2003, and 2006 sample sets is remarkably uniform in the medium sand range (1 to 2 phi), with good to moderate sorting values.

Please feel free to contact me if you have any further questions.

Yours truly,

A handwritten signature in black ink that reads "Peter S. Rosen". The signature is written in a cursive, flowing style.

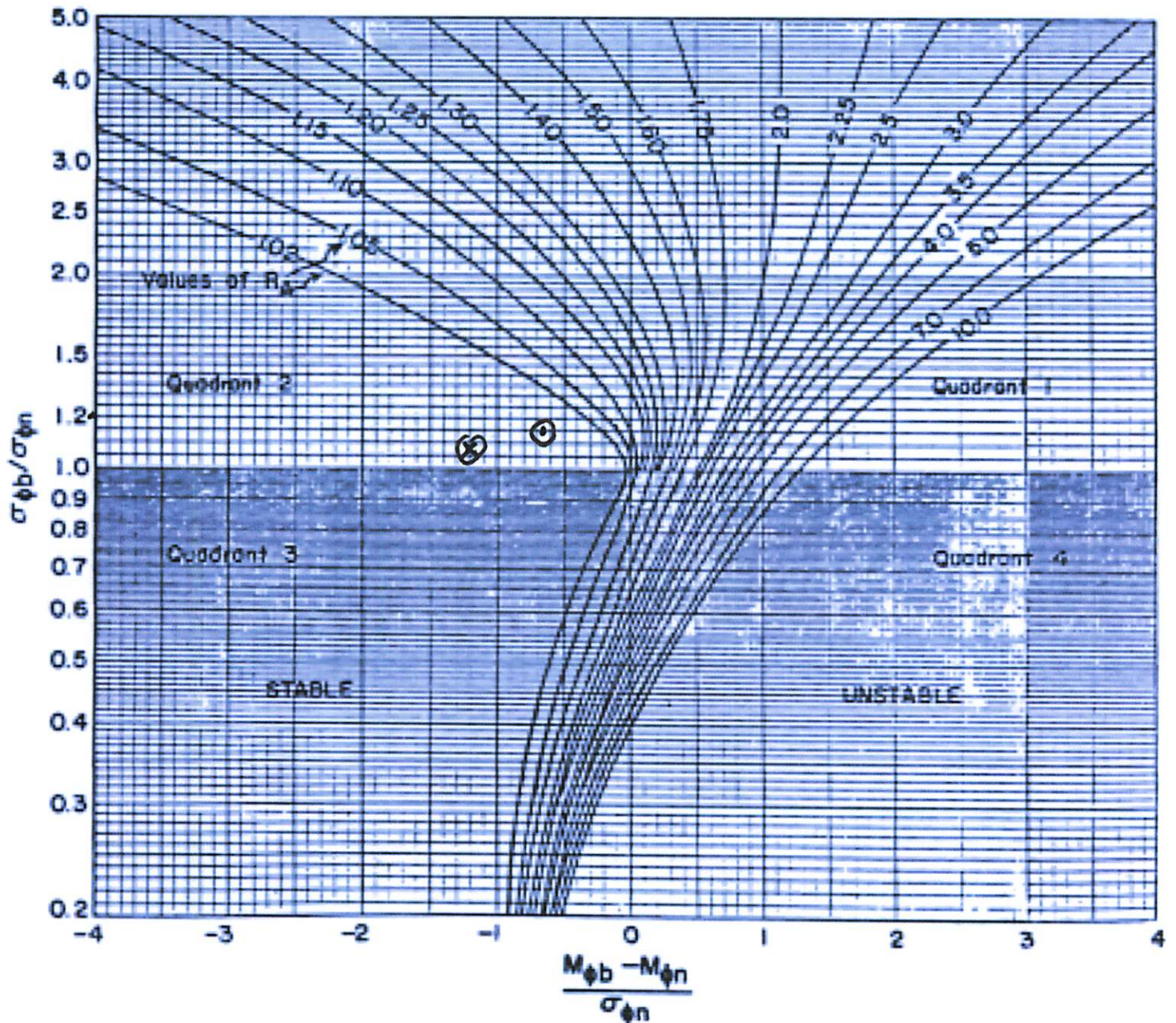
Peter S. Rosen, Ph. D.
Coastal Geologist

Attachments:

1. James Overfill Factor Plot
2. Data worksheet

JAMES OVERFILL FACTOR (R_A)

'BEACH': 2006 BANK COMPOSITE
FROM REVETMENT AREA.



SOURCE: \odot HOLOGATE
 \otimes REIS

Sconset Beach James Overfill Calculation Worksheet
Borrow area to bank comparisons

4-Sep-13

Borrow Area:	Beach/Bank	sd borrow/ sd beach	mean borrow - mean beach/ sd beach	Overfill Factor (RA)
Holdgate Pit	2006 bank data	1.14	-0.66	1
Reis Pit	2006 bank data	1.09	-1.21	1
Bank Composite	(based on samples in revetment project area)			
2006 bank composite	mean	1.34		
	sd	1.17		

2006 Bank Samples within Revetment area		
	Mean (phi)	Phi Sorting
L12 UBK	2	0.95
L12 MBK	1.14	1.28
L12 LBK	1.15	0.85
L13 UBK	2.4	0.93
L13 MBK	2.48	1.17
L13 LBK	0.57	0.77
L14 UBK	1.25	0.73
L14 MBK	1.78	1.36
L14 LBK	1.31	1.02
L15 UBK	1.26	1.31
L15 MBK	1.8	1.38
L15 LBK	1.48	1.44
L16 UBK	1.2	1.51
L16 MBK	1.23	1.3
L16 LBK	0.96	1.37
L17 UBK	1.12	1.42
L17 MBK	1.44	1.32
L17 LBK	0.73	1.22
L18 UBK	1.37	1
L18 MBK	0.8	1.01
L18 LBK	0.76	1.2
Mean of Samples in Revetment Project Area		
	1.34	1.17

Source:

2006 Data from CP&E spreadsheets, Lines 12-18

**BAXTER ROAD AND SCONSET BLUFF STORM DAMAGE PREVENTION PROJECT
NOTICE OF INTENT (DEP FILE NO. SE 048-2581)**

PROPOSED SAND MITIGATION PLAN AND MONITORING SYSTEM

September 6, 2013

General Commitment

The Applicant commits to deliver 12 cubic yard/linear foot per year of sand (Base Amount). Approximately 4 cubic yards/foot will be placed along the revetment and within approximately 300-feet to the north and south in the late spring and early fall prior to the start of the winter storm season each year, with 8 cubic yards/foot held in reserve to be delivered during the winter storm season as needed. The following conditions will trigger placement of all or part of the reserve portion of the Base Amount:

- Prevention of scour of the fronting beach and maintenance of the revetment's structural integrity: If one layer of the revetment toe becomes exposed, SBPF will as expeditiously as possible supply sufficient sand to again cover that layer.
- Prevention of flanking or end scour: The areas within 300 feet of the ends of the revetment will be visually monitored and photo-documented on a monthly basis from November-March. Additionally, the visual monitoring will be supplemented by semi-annual monitoring of transects located 0, 100, 200, and 300 feet from each end of the revetment (see attached Figure 1). If this monitoring indicates a discontinuous shoreline recession adjacent to the revetment, additional sand will be placed in that area.

The Base Amount will not be exceeded except under the conditions described below in the "Delivery in Excess of the Base Amount" section.

Delivery in Excess of the Base Amount

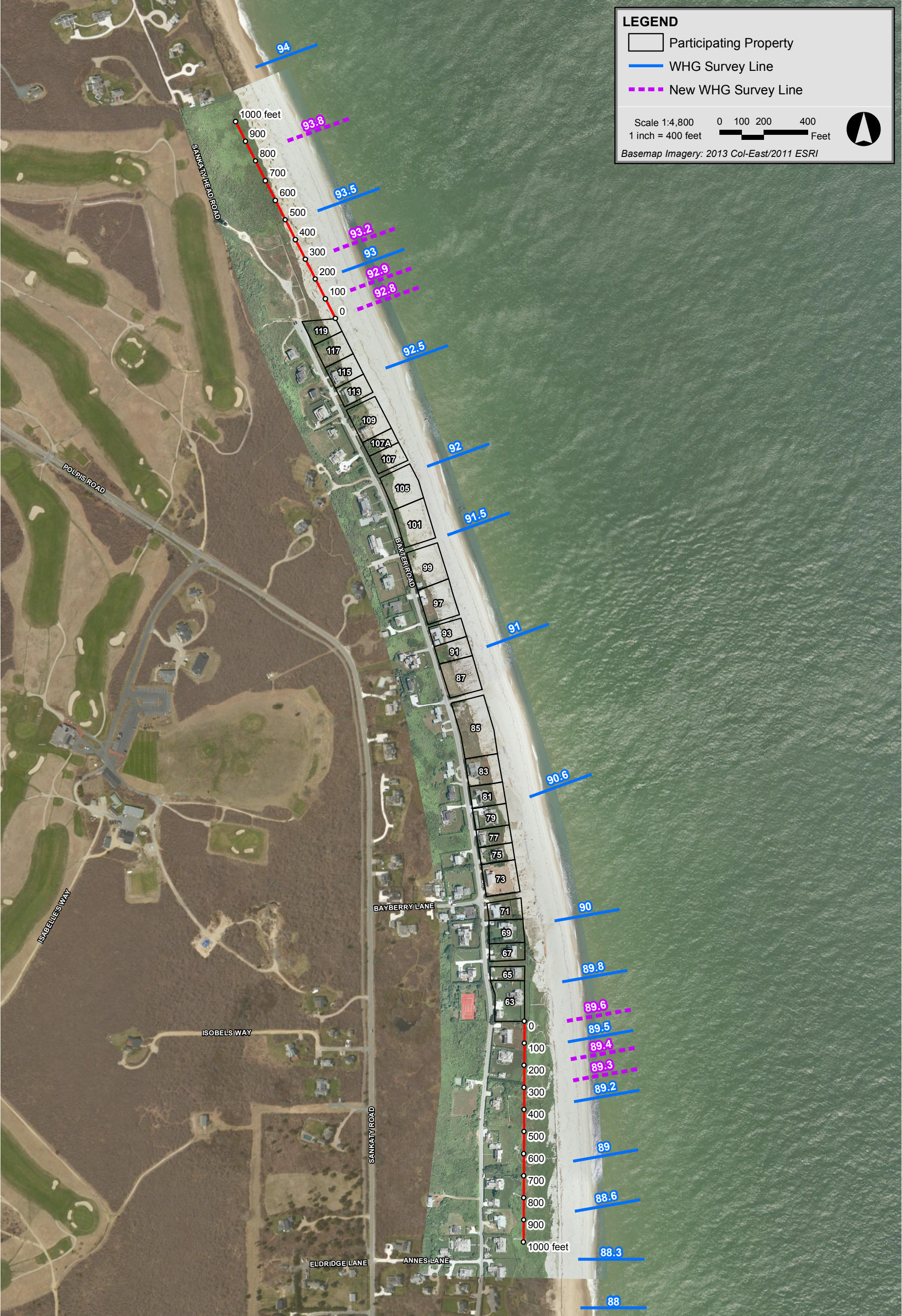
In some years because of extraordinary storm activity, it may be necessary to deliver more than the Base Amount in order to address issues of scour at the ends or the front of the revetment. Any oversupply of sand delivered to the project may be deducted from future years' delivery requirements.

The situations in which delivery of sand in excess of the Base Amount would occur are:

- Exposed revetment toe: If one layer of the revetment toe becomes exposed after the Base Amount has been supplied, additional sand will be provided as expeditiously as possible to cover this layer.
- Observation of flanking or end scour: If the monthly visual observations or semi-annual monitoring of transects located 0, 100, 200, and 300 feet from each end of the revetment (as described above) document a discontinuous shoreline recession within 300 feet of the ends of the revetments after the Base Amount has been supplied, additional sand will be placed in these areas.

Tracking of Volume of Sand Delivered

Sand deliveries will be carefully tracked, so that the volume placed in a given 1-year period (starting from the time the initial sand mitigation amount is placed in late spring) can be determined. Any amount delivered in excess of Base Amount may be deducted from one or more future years' delivery requirements in any of the subsequent 5 years. In no case will the average amount of sand delivered per year fall below the Base Amount during the life of the project. Any year in which less than Base Amount is to be delivered is allowed only because it offsets a prior year in which greater than the Base Amount was delivered.



Baxter Road and Sconset Bluff Storm Damage Prevention Project Nantucket, MA

Figure 1
WHG Survey Lines